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ASTM BULLETIN

Published by
AMERICAN SOCIETY for TESTING MATERIALS

This Issue Contains

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MAY—1944
No. 128

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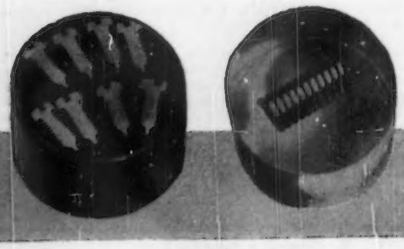

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Number 128 May 1944

Forty-seventh Annual Meeting, New York June 26 to 30

16 Technical Sessions with some 100 Technical Contributions; Committee Meetings Throughout the Week

While it will be noted from this article and the detailed Provisional Program published elsewhere in this Bulletin that there are certain round tables and symposiums featuring the Annual Meeting, for example, on such topics as centrifugal castings, interpretation of water analyses, analytical colorimetry and photometry, etc., there are also in the 16 technical sessions necessary to provide time and discussion of the technical papers and reports, other groups of papers that will be of direct interest and concern to large groups of materials and testing technologists. Some of these topics include plastics, nonferrous metals and alloys, concrete and concrete aggregates, cement, and many others.

Most of the committee reports and many of the technical papers will be preprinted in advance and distribution made to those members who have requested copies, a request blank having been distributed in a separate mailing concurrently with this Bulletin.

New York City

The selection of New York City as the location for the Society's Forty-seventh Annual Meeting is logical considering that the Spring Meeting was held in Cincinnati in March, the 1943 Annual Meeting in Pittsburgh, and including the fact that the greatest concentration of A.S.T.M. members and committee people is in the metropolitan area, with Philadelphia and the New England members near by. The excellent facilities of The Waldorf-Astoria for technical meetings will be used with various other hotels cooperating in connection with sleeping room accommodations. While it is not expected that the record-breaking attendance at the 1937 meeting in New York will be broken (1553 members, visitors, etc.), an excellent registration is anticipated.

Committee Meetings

The arrangement of a technical program for the meeting is always complicated by the necessity of providing logical meeting times for the large number of technical committees that have always convened during the Annual Meeting of the Society. It is expected that from 200 to 250 technical groups will be meeting throughout the five days of the week with all day Monday, and Tuesday and Thursday evenings, free of sessions and available for such meetings. Complete schedules of committee meetings will be forwarded by the respective groups and information on meeting rooms will be available at the A.S.T.M. Registration Desk.

With publication of the 1945 Book of Standards advanced one full year to appear late in 1944, more than the usual number of committees may convene.

Edgar Marburg Lecture—General Session

Edgar Marburg Lecture:

The Society's Nineteenth Edgar Marburg Lecture will be presented on June 28 at 4:15 o'clock by Dr. Harold DeWitt Smith of A. M. Tenney Associates, New York City, on the subject "Textile Fibers—An Engineering Approach to an Understanding of Their Properties and Utilization." Some information on the lecturer's background and a short synopsis of the lecture appear on an adjoining page. This subject is pertinent because of the intense interest in both natural and synthetic fibers and the potential uses that are developing for them. As an outstanding technologist in this field, Dr. Smith may be expected to present an authoritative and interesting lecture.

General Session—Address on Minerals and World Peace; President's Address:

Featuring the Society's general session which this year is to be held on Wednesday evening, June 28, will be the address of the retiring President, Dean Harvey, and a guest address by Dr. Charles K. Leith on "Minerals and World Peace."

Retiring presidents of the Society have discussed various problems, some have covered technical phases of the industry with which they were most closely associated,

others have stressed important points in connection with the work of the Society, and a few have departed from technical and engineering discussions to talk on non-technical subjects; for example, H. S. Vassar covered the "testing of nonmaterials" in his 1936 address in which he referred to some of the human and social problems with which the engineer is concerned. Dean Harvey, this year in selecting as his subject the "Art of Living" with particular emphasis on relation of this topic to the materials engineer and technologist, will discuss matters of interest to all engineers.

Dr. Leith who has accepted the invitation to present the guest address at the general session is an authority on the subject, which is one of increasing significance. Some notes on the speaker and his subject are included in another portion of this article.

Honorary Members:

Honorary memberships will be awarded to three outstanding long-time leaders in the Society's work at this session.

At this general session the newly elected officers are introduced and recognition will be given to members who since last year have joined the distinctive 40-year class.

Round Table on Properties of Centrifugal Castings

Realization of the growing importance of the centrifugal castings process in producing certain types of cast products has led to the organization of a small committee headed by N. L. Mochel, Westinghouse Electric and Manufacturing Co. to sponsor a round-table discussion at which leading producers and those concerned with use of centrifugal cast parts will discuss various factors involved in determining the quality of the products. A. E. Schuh, United States Pipe and Foundry Co., J. T. MacKenzie, American Cast Iron Pipe Co., and other leaders in the industry are serving on the informal committee.

The committee is enlisting the participation of metallurgists and technical people who will speak from the standpoint of steel castings, and various brass, bronze, and other non-ferrous products. The chief purpose is to stress factors involved in determining quality such as type of test specimens, how best they can be obtained, whether they are truly representative of the particular series of parts, etc. Some discussion on methods and other features of the process will be provided primarily as background material.

Recently various sessions have been held, and papers presented dealing with centrifugal castings. For example, the June, 1944, issue of *Transactions* of the American Foundrymen's Association includes a paper on "The Hows and Whys of Centrifugal Casting" and a symposium was held at their annual meeting in Buffalo in April. In the A.S.T.M. Round Table the American Foundrymen's Association is participating officially through representation on the committee in charge. Tuesday morning, June 27, has been set aside for this feature of the Annual Meeting.

Analytical Colorimetry and Photometry

Under the joint sponsorship of Committees E-2 on Spectrographic Analysis and E-3 on Chemical Analysis of Metals, a Symposium on Analytical Colorimetry and

Courtesy American Foundrymen's Association

Pouring Centrifugal Castings

Minerals and World Peace

Dr. C. K. Leith, who will present the guest address at the general session of the Annual Meeting on Wednesday, June 28, has submitted a short, very general statement of the content of his address, explaining that he will not reach decision on the specific points he will cover until a short time before the meeting. A number of important developments are under way which may be reflected in his address:

Discussion of minerals not as museum specimens, but as the raw materials for industry and implements of war.

The growing interdependence of nations due to expanding needs of world industry, both for volume and variety of mineral products.

The resulting rivalry of nations for mineral supplies.

Changing position of the United States as the world's leading producer of minerals both at home and abroad.

The resulting new problems of foreign relations.

The necessity of an over-all United States mineral policy, domestic and foreign, to meet new conditions and to minimize the growing threat to world peace inherent in the world mineral situation.

Biographical Sketch:

For many years, Dr. Leith has been Professor of Geology at the University of Wisconsin, and a widely known Mineral Consultant. In the latter capacity he served the Shipping and War Industries Boards in World War I, and also the American Commission to Negotiate Peace in Paris in 1919. He was a leader in round-table discussions on minerals in their public and international relations—Institute of Politics, Williamstown, Mass., 1925–1926; British Institute of International Affairs, London, 1926; Institute of International Relations, Portland, Oregon, 1932; Council on Foreign Relations, New York, 1933. Other prominent activities or responsibilities included service as Vice-Chairman, Planning Commission for Mineral Policy, appointed by the President, 1934–1937. He has been Consultant, National Resources Board since 1937, and his most recent activities have included since 1940 Mineral Consultant to the Advisory commission to the Council of National Defense and successor organizations—now the War Production Board. He has prepared many articles and books on mineral resources and their public relations.

Dr. Charles K. Leith

The Waldorf

Photometry, comprising two sessions of the Annual Meeting, will be held on Wednesday morning and afternoon. These two standing committees have cooperated in other technical symposiums, notably in 1940 when there was an extensive Symposium on Spectrographic Analysis, and Committee E-3 sponsored the related Symposium on Tools of Analytical Chemistry.

A rather comprehensive program is being developed to provide latest information on problems involved in the general subjects. Following a general introduction, it is planned to have discussion cover photoelectric cells, filter photometers (discussion of available types of instruments, circuits, uses, etc.), spectrophotometers (available types, infrared, ultraviolet, circuits, advantages, limitations, etc.), and then discussion of errors involved in application of instruments. Then would be incorporated discussion on chemical principles, a bibliography, and then a group of papers covering specific methods for use in certain fields, for example, aluminum-base alloys, magnesium-base material, ferrous alloys where the use for determining manganese, phosphorus, copper, and nickel will be covered, and a similar plan followed in nonferrous alloys. (See Provisional Program)

The numerous details of planning for this work are being handled by D. R. Evans, Chemical Engineer, Western Electric Co., Inc., Mr. Evans being chairman of Division B on Non-Ferrous Metals of the Chemical Analysis Committee. The chairmen and secretaries of the two standing committees are cooperating.

Discussion on Interpretation of Industrial Waters

A separate technical session that will be of great interest to all technologists and others concerned with the classification of industrial waters and the use of water in the various industries and, of course, as boiler feedwater, has been planned by Committee D-19 on Water for Industrial Uses with Max Hecht, Chairman, coordinating various details. Committee D-19 has for the past several years held round-table discussions or symposiums on problems that are of distinct importance; for example, at the 1943 meeting there was the Symposium on the Identification of Water-Formed Deposits, Scales, and Corrosion Products by Physico-Chemical Methods with several technical papers and discussion (this is published in the 1944 *Proceedings* and is available separately as announced elsewhere in this Bulletin).

Among those participating in the discussion are W. C. Schroeder, W. D. Collins, J. A. Holmes, R. E. Hall, and L. B. Miller. For details of the papers, see the Provisional Program in this Bulletin. Dr. Schroeder in his paper on "Classification of Industrial Waters" is introducing the discussion, setting a background for appreciating the significance of the presentations which follow, and he will also serve as chairman of the session. He has prepared an interesting statement on the problem which is published in an adjoining column. Preprints of certain of the items are being prepared and will be distributed to members on request—the items are listed on the preprint request blank that is being sent. This session is scheduled for Tuesday afternoon, June 27.

Other Technical Sessions

It will be noted there are three simultaneous sessions scheduled for 2 o'clock, one involving fatigue and methods of testing, another a miscellaneous group of

Examples of Centrifugal Castings

STATEMENT

Discussion on Organizing the Interpretation of Industrial Waters

2 p.m.—June 27, 1944

THROUGH the work of A.S.T.M. Committee D-19 on Water for Industrial Uses, there have been developed practical, accurate, and standardized procedures for sampling and determining essentially all the significant constituents in waters. This has been coupled with a carefully thought-out method of reporting results which indicates exactly what is in the sample, without ambiguity, and without arbitrary systems of calculations which end up in indicating compounds which cannot possibly be present.

The chief and remaining problem is this—"What do the Results of the Analysis Mean?" Unfortunately, to most engineers and to quite a few chemists, they mean little or nothing. If they do have meaning, it is only because the interpreter has sufficient, intimate experience with water problems to judge the analysis of an unknown sample against a background of analysis of water samples whose characteristics and effects he knows from practical application.

What can be done to make the analysis of a water sample an understandable and useful tool, even for those individuals who are not specialists in this field? In essence the problem resolves to a systematic, succinct, and understandable presentation of the relationship of a water analysis to its actual effect in an industrial process. The authors of the papers and the members of the committee engaged in this attempt at classification will be the first to admit its difficulties and yet, if industrial water treatment is to crawl out of the realm of a sort of mysterious alchemy for the average engineer and executive, it is a job that must be done.

Classification of industrial waters might be tried on the basis of formulas or graphs with definite lines of demarcation and fixed interpretation. Indeed for certain specific processes and applications, this has already been done with success in some instances and relative failure in others. To develop such schemes for a wide variety of waters used in numerous industrial processes seems either impossible or beyond our understanding at the present time.

The plan for classification which now looks most promising, which retains the necessary flexibility, and yet which gives even the layman a basis on which to judge his particular water sample from its analysis, is to describe the effect in various industrial processes of individual water samples selected as standards. The analysis of the unknown sample can be compared with the analyses of these standards and the description of the way these standard waters act in a definite application. Conclusions can then be reached as to how the unknown sample will act in a similar use.

Thus far, nine waters, representative of those that may be used industrially throughout the United States have been selected for standards. Complete analyses are available for these waters.

The first paper will discuss the reasons for selecting these nine waters, how generally they are encountered, and indicate other waters that might be included in the standard group. The second paper will describe the uses and difficulties that may be encountered with each standard sample in certain phases of paper manufacture. The last two papers will tell how these standard waters will act when used for feedwater in low- and high-pressure boilers.

The authors of the papers and the subcommittee on classification solicit active participation in this discussion. Such discussion and suggestions will help to build a real method for making water analysis useful.

topics including timber, electrical in sulating materials, rubber products, and plastics, with several technical papers on the latter subject which continues to be of intense technical interest. The third involves industrial waters.

Wednesday morning is a very busy period, with the two features, one on centrifugal castings, and another on analytical colorimetry and photometry, and in addition a third session made up largely of committee reports covering petroleum, coal, bituminous materials and soils, etc.

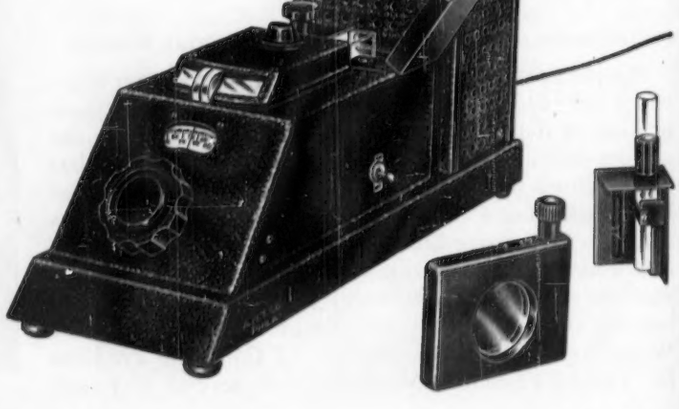
Then, concurrently with the second part of the photometry and colorimetry symposium is the eighth session on paints, paper, textiles, and soap. These two afternoon sessions are scheduled to end at 4 o'clock with the Marburg Lecture on textile fibers starting promptly at 4:15.

THURSDAY AND FRIDAY SESSIONS

The eleventh session, Thursday morning, June 29, is devoted to ferrous materials with reports of the Steel Committee, A-5 on Corrosion of Iron and Steel, Joint Research Committee on Effect of Temperature, Committee on Metallography, and others, in the "A" Group. Running concurrently with this is a session comprising committee reports in the cementitious and refractories fields, with technical papers on mortars, cement, etc.

Thursday afternoon is the first of two sessions on nonferrous metals and alloys, with several of the "B" committees reporting and papers covering applications of the salt-spray test, an alternate immersion test for certain aluminum copper alloys, and discussion on test specimens for copper-base alloys, and others. At this same time, 2 p.m., is the first of two extensive sessions on concrete and concrete aggregates, with technical discussion on such topics as the following: Concrete pavement construction of military airfields; measurement of concrete strength by embedded pull-out bars; effect of entrained air on the various constituents of portland cement concrete; and application of fly ash for lean concrete mixes. This session continues on Friday morning with other papers on the following: Some properties of concrete

A photoelectric colorimeter, one of various types particularly suitable for use in industrial laboratories. Used for determinations over a wide range of colored or turbid solutions; one use, for example, being in the determination of molybdenum in steel.



Skyline from Central Park

under sustained combined stress; some investigations of the modified cube test; long-time concrete tests comparing dynamic (sonic) and compressive modulus of elasticity, modulus of rupture, and compressive strengths on a California concrete paving project.

The final session, the sixteenth, on Friday morning, contains reports on light metals and alloys, die-cast metals, electrodeposited coatings, and papers covering short-time tests of soldered joints, routine metallographic examination of commercial magnesium alloys, and others.

Preprints Sent on Request

In a separate mailing there is being sent to each A.S.T.M. member a Preprint Request Blank by which he can request a copy of any of the technical papers and reports preprinted in advance of the meeting. This blank should be returned promptly and should be carefully marked. The Provisional Program will enable members to make a selection of the items desired. Preprints will be forwarded to those members in good standing in two or three installments. *Members should note that preprints will not be sent unless requested.*

Transportation Reservations Should Be Made Early

Undoubtedly many of the members and committee members have had sufficient experience with the heavy traffic now prevalent so that a warning to make transportation reservations sufficiently early is unnecessary. Nevertheless, it is urged that each person planning to attend the annual meeting make arrangements for transportation well in advance. There are no special rates in effect.

Hotel Reservations, Advance Registration

A return form for making reservations for sleeping room accom modations has been sent to each member and committee member and it was urged that this be returned very promptly following the instructions on the form. While the Headquarters Hotel is the Waldorf-Astoria and all technical sessions will be held there, because of the anticipated size of the meeting and the tremendous demand for accommodations, other hotels are cooperating in connection with sleeping rooms.

There was also mailed a meeting reservation card which should be filled out and mailed promptly to A.S.T.M. Headquarters in order to take care of as many details as possible in advance.

A.S.T.M. Registration Desk.—The A.S.T.M. Registration Desk will be in the Basildon Room on the third floor. Most of the meeting features will be concentrated on this floor, but, of course, committee meetings will be in progress in various parts of the hotel. Full details of the meeting will be available at the Registration Desk and each member is urged to register promptly. The desk can be designated as a meeting place for members who wish to contact each other.

Ladies Registration.—Even though there is no formal entertainment planned, ladies attending the meeting with members are cordially invited to register at the Ladies Registration Desk which will be adjacent to the regular A.S.T.M. Registration Desk on the third floor.

Entertainment

Following the procedure of last year and in keeping with the business nature of this streamlined meeting held during a war period, no formal plans are being made for entertainment of members and their families, but New York City offers many interesting places to visit and other forms of entertainment. The New York Convention and Visitors Bureau will have a representative on duty at all times near the A.S.T.M. Registration Desk with detailed information about the city and trips that are available. The representative will have a supply of broadcast tickets.

RCA Building

Theaters and Shows—The McBride Theater Ticket Agency at The Waldorf-Astoria will cooperate with members in securing such advance seats as will be available for shows, plays, etc., that will be running during the A.S.T.M. Annual Meeting. Members are urged to write the agency well in advance if they wish to procure tickets. This procedure will enable members to get reasonably-good seats at legitimate prices.

1944 Edgar Marburg Lecture

Dr. Harold DeWitt Smith Will Discuss "Textile Fibers—An Engineering Approach"

Dr. Harold DeWitt Smith

In selecting the 1944 Edgar Marburg Lecturer, Dr. Harold DeWitt Smith, of A. M. Tenney Associates, New York City, who has accepted this honor and chosen as his subject "Textile Fibers—An Engineering Approach to an Understanding of Their Properties and Utilization," the Edgar Marburg Lecture Committee and Executive Committee have had in mind the very important work which Committee D-13 on Textile Materials has been carrying out for years in this field, have been cognizant of the intense interest in all kinds of natural and synthetic fibers and thus have chosen a lecturer and topic in keeping with the locale of the Annual Meeting in New York City. An outstanding authority in his field, Dr. Smith has been active in many scientific and technical societies and as an active member of A.S.T.M. serves on Committee D-13, where A. M. Tenney, his associate, is chairman of the subcommittee on rayon and its products. This lecture will be the feature of the Ninth Session Wednesday afternoon, June 28 at 4:15 o'clock. A synopsis of the lecture follows.

Synopsis

Textile Fibers—An Engineering Approach to an Understanding of Their Properties and Utilization

The advent of manufactured fibers and their increasing variety and amount make it essential to transform the basis of our thinking about and utilization of textile fibers from that of a practical art to that of an engineering science.

Instead of a few natural fibers with relatively immutable properties, we have a growing profusion of man-made fibers whose forms, and many of whose properties, can be varied at will far beyond the limits attained by the most careful breeding and cultivation of nature's product.

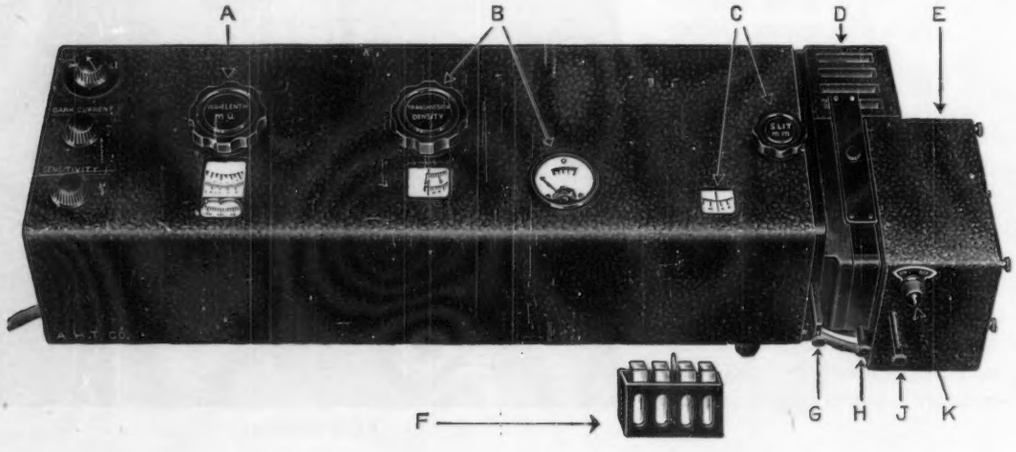
In a mechanical sense, textile fibers are tiny beams. Therefore a study of their mechanical properties, such as strength, stiffness, resilience, elasticity, surface friction, etc., in relation to the properties desired in textile yarns and fabrics is offered as important to the esthetic characteristics as well as to the utilitarian values of textiles.

Editor's Note.—In submitting the accompanying half-tone for the May Bulletin, Dr. Smith has promised a more recent photograph for use in the finally published Marburg Lecture, indicating that some years ago he developed a "photographic allergy." The reproduction above is a vintage of about 1933–1934.

About the Lecturer

A graduate of Lehigh University where his Ch.E. degree was received in 1920, and where the honors of membership in Tau Beta Pi and Sigma Xi were accorded, Dr. Smith spent two years in the rubber and vegetable oil industry, and joined Wellington Sears Co. in 1922. From 1922 to 1927, he had charge of the New York laboratory, and was engaged in the chemical and physical testing of textiles, including cotton, silk, wool, and rayon. These were the years during which rayon was introduced into cotton mills and the development was attended with many problems involved in the use of this new material. In 1927 he resigned in order to study the chemistry and physics of cellulose and of textile fibers in Germany.

The years from 1927 to 1930 were spent as guest worker at the Kaiser Wilhelm Institute for Fiber Chemistry in Dahlem, near Berlin, and graduate student at the Univer-



A photoelectric quartz spectrophotometer which can be used in a wide variety of research and control work. Discussion of instruments of this type and their potentialities will occupy an important place in the Symposium on Analytical Colorimetric and Photometric Analysis, June 28, New York City.

sity of Berlin. He was awarded a Ph.D. degree in physical chemistry in 1930. Since 1930, Dr. Smith has been a member (and Treasurer) of A. M. Tenney Associates Inc., which is sole sales representative for the cellulose acetate rayons manufactured by Tennessee Eastman Corp. During the first year or two, the organization was engaged in the testing and developing of the experimental yarns which were being made by Tennessee Eastman. Dr. Smith has been in charge of sales service since 1932 which includes the development of new uses, the investigating of complaints, and general technical assistance to the sales force. Inasmuch as the development and the utilization of the various rayon fibers involve a thorough understanding of the properties of the natural fibers and of the general technology of textile manufacture, Dr. Smith's hobby, as well as his work, during the last fourteen years has been to learn all he could about textiles. Like any subject vigorously pursued, the study of textiles provides a framework within which almost all of one's knowledge of history, culture, and commerce as well as science can be oriented.

Dr. Smith has written a large number of technical papers published in this country and abroad and has prepared chapters dealing with acetate rayon in various handbooks. He is at present Vice-President of the Textile Research Institute, Inc., Trustee of the Textile Museum in Washington, member of the Scientific Advisory Committee, Textile Foundation, and of the Advisory Board, Research and Development Branch, Office of the Quartermaster General, U.S.A. and holds membership in addition to A.S.T.M. in numerous societies and organizations, including the A.A.A.S., American Association of Textile Chemists and Colorists, The Faraday Society, and the Society of the Chemical Industry (England). He has been a Fellow of The Textile Institute of England since 1932 and an honorary life member for the past six years.

Pertinent Facts on New York City

History

Discovered by Henry Hudson, September 11, 1609, Manhattan Island was inhabited by white men for the first time in 1613. In 1626 the island was purchased by the Dutch through Peter Minuit from the Indians for trinkets valued at about $24. Fort Amsterdam was built on the site of the present custom house in 1635. In 1673 New Netherland, including the City of New Orange, was ceded to England and both province and city renamed New York. In 1756 a stage route was established between New York and Philadelphia, and in 1770 the first conflict of the Revolution occurred when English soldiers destroyed the Liberty Pole on the site of City Hall Park. During the Revolution the city was occupied by the British and remained occupied until 1783. The steamship Clermont, "Fulton's Folly," left New York on its maiden trip in 1807, and the first steamship to cross the Atlantic, the Savannah set out from New York in 1819. In 1832 the first horse railroad started, and in the same year the first street car operated. In 1846 a telegraph line between New York and Philadelphia was opened, in 1858 the first message by Atlantic Cable was received, and in 1900 excavation was made for the first subway.

Museums

New York has more than thirty museums, including The Metropolitan Museum of Art, New York Museum of Science and Industry, and the famous Museum of Natural History.

Famous Homes

Also in New York can be found the Roosevelt House, birthplace of Theodore Roosevelt, Poe's Cottage, the Jumel Mansion used by Washington as headquarters when the American Army retreated through New York, and the Fraunces Tavern where George Washington made his farewell to his officers.

Churches

Some of the oldest historic churches in America are found in New York, including St. Paul's, 1766, where both Washington and Clinton worshipped; St. Mark's-in-the-Bouwerie where Stuyvesant is buried, Old Trinity, and others. Of the newer churches, there is the famous Cathedral of St. John the Divine, St. Bartholomew, St. Patrick's Cathedral and Temple Emanu-el.

Skyscrapers

New York has 2500 buildings ten or more stories high, and there are 97 skyscrapers over 30 stories, of which the Empire State Building is the highest with 102 stories, 1250 ft. in all. The Chrysler Building and the R.C.A. Building in Rockefeller Center follow in turn.

Transportation

New York's three subway systems represent a total investment of $1,702,000,000, over half of which has come from the city's treasury.

Harbor Facilities

New York has more than 900 miles of water front, and more than 5000 vessels of 125 steamship lines enter and clear many times from the harbor each year. It is estimated that approximately 44 per cent of the value of the entire normal foreign trade of the United States is carried on through New York Harbor. Sixteen ferries connect New York's boroughs with adjacent communities.

NOTE.—The above information is based on material furnished by the New York Convention and Visitors Bureau.

"The New York Visitor"

AMONG THE various publications relating to New York is "The New York Visitor," comprising a magazine of metropolitan events and handbook of New York City as issued by the New York Central Railroad Co. A year's subscription, twelve issues, is $1.00; cost of single copies, 10 cents. Some of the members may wish to procure copies of the May and June issues, and they can do so by writing to Room 1264, 466 Lexington Ave., New York, N. Y., including the necessary remittance. In addition to current news on places of interest, where to go, shows, hotels, etc., there are interesting feature articles, the March issue, for example, covering the Federal Hall Museum, and a most interesting "Fire Fans' Paradise" at the Home Insurance Co. building.

What's in a Name

FROM TIME to time, members of The Headquarters Staff find themselves addressed by strange and frequently very amusing names, some appellations being stenographers' errors and possibly in a few cases sincere misunderstandings. It is not uncommon for the "American Society *of* Testing Materials" to be noted even in places where such errors should not occur (we can easily conceive of a society of butchers, bakers, and candlestick makers but never one *of* testing materials), but the case which takes the "cake" and also has the ultimate of chagrin was the recent communication addressed "The American Society Protesting Materials."

Developments in Tests and Specifications for Concrete and Concrete Aggregates

At its one day meeting late in March in Pittsburgh, Committee C-9 on Concrete and Concrete Aggregates acted on a number of important recommendations coming from its various subcommittees, several of these groups having met earlier in the month during the annual meeting of the American Concrete Institute in Chicago. There has been notable activity on the part of Subcommittee VII on Methods and Apparatus, resulting among other items in the acceptance for publication as information, with the annual report of Committee C-9, of an interesting discussion on a volumetric method for determining air content by J. C. Pearson. Considerable work has been carried out using a large pycnometer. After the data were studied it was concluded that the volumetric method gave nearly as dependable results for air content as did the standard, and has the distinct advantages of taking less time and much less computation, and furthermore, the equipment can be carried in a small handbag which with a piece of plank, a flat slab, and a bucket of water enables the user to set himself up in business.

Changes are to be recommended in various test methods including those for making and curing compression and flexural specimens in the laboratory (C 39 and C 78) where accurate control of quantities of materials and test conditions is possible. Other methods to be modified cover compressive strength of molded cylinders (C 39); also another one covering tests for flexural strength (simple beam third-point loading) (C 78); another covering securing and testing specimens from structures and pavements (C 42); and making and curing specimens in the field (C 31); also the test for unit weight and air content (C 138). Two items are to be voted on for adoption as standard—sampling fresh concrete (C 172) and measuring length of drilled concrete cores (C 174).

The much discussed specifications for ready-mixed concrete which were extensively revised in 1943 and issued as tentative specifications C 94, will, after a number of changes that are primarily of an editorial and rearrangement nature, be recommended for adoption as standard. In the field of curing, the test for determining water retention efficiency of materials for curing concrete (C 156) which is intended for laboratory testing is to be revised an offered for adoption as standard.

The committee discussed the desirability of preparing a manual on testing concrete which would include considerable explanatory material with appropriate reference to the established standard methods. The manual on testing cement which supplements the standard methods in this field is considered very valuable and there is a need for a corresponding manual for concrete. Active preparation of the material is expected to start soon.

Other actions were recommended by a group concerned with specifications and tests of aggregates. Changes in the test for soundness (C 88) are being approved. This method, which is intended to supply helpful information on the soundness of aggregates subject to weathering action determines their resistance to disintegration by saturated solutions of sodium sulfate or magnesium sulfate. The intention is to continue this test as tentative. Because the present freezing-and-thawing test for soundness of aggregates (C 137) needs to be drastically revised and brought up to date, it is to be withdrawn. A new method of determining surface moisture has been approved and when this is issued the current standard will be withdrawn. The proposed revisions issued in 1941 involving abrasive charge and test sample used in the Los Angeles abrasion test for coarse aggregate are to be adopted. A series of tests to develop procedures for evaluating large size aggregates is to be carried out through the cooperation of several groups represented on the committee.

Committee Work on Glass and Glass Products

At its meeting on April 5 in Pittsburgh, Committee C-14 on Glass and Glass Products reviewed a number of phases of its work and received reports of several of the subcommittees including one covering nomenclature and definitions where the most perplexing problem has been to reach agreement on a sound technical definition of the term "glass." Legal aspects of such definitions are being considered.

In the work on chemical properties, three proposed methods for determining chemical durability have been drafted and they are being referred to other subcommittees on glass containers and pharmaceutical containers for consideration and approval; the latter is to use the methods in a round-robin survey among several laboratories. The first method covers chemical durability of glass used for manufacture of glass containers in which glasses of the soda-lime type are crushed and subjected to attack by water or dilute acid at 90 C.; the other two tests relate to chemical durability of glass containers in the first of which glass containers of the soda-lime type are filled with water or dilute acid and subjected to a temperature of 120 C. in an autoclave, and in the second test the containers are subjected to a temperature of 90 C.

One problem in the work on glass construction block and tile is to coordinate different ideas on standard test methods and specifications. It is possible that agreement can be reached on testing individual units, but there are further problems involved in testing structural units made up of blocks.

Another activity involves glass containers where the ring section methods of examining glass containers for cord as worked out by the Glass Container Association is being considered as a tentative method for A.S.T.M.

In order to develop standarized specifications for flat glass the subcommittee in charge is reviewing existing specifications with the thought of agreeing on a standard. One project on which the committee had planned to undertake work was the effect of explosive forces on flat glass but this is being, temporarily at least, held in abeyance because of the favorable progress of the war effort.

Preliminary Studies on a Drop Ball Impact Machine*

By George Lubin[1] and Roswell R. Winans[1]

THE MACHINE described in this paper was developed originally for testing fatigue of plastics in connection with the investigations originated by the Bell Telephone Laboratories.[2] After the machine was constructed it was found that it could be used as well as a single-blow impact machine to determine the impact energy or impact strength of standard Izod test specimens.

It has been found by Telfair and Nason[3] and by Callender,[4] that the present method for measuring the shock resistance or impact strength of plastics possesses several serious disadvantages. The Izod type pendulum machine now used for determining the impact strength consists of a weighted pendulum released from a height of 2 ft. and striking the sample at the point of maximum velocity. At that point the pendulum has a considerable excess of energy over that necessary to break the specimen. It has been suggested[3, 4] that the impact strength or energy indicated by the Izod method is really a sum of several different energies, namely:

(*a*) Energy to initiate fracture of the specimen,
(*b*) Energy to propagate the fracture across the specimen,
(*c*) Kinetic energy imparted to the broken ends of the specimen, and
(*d*) Other energy losses due to friction, vibration, and plastic deformation.

Of the above energies, (*a*) is the only one of interest, since it comes nearest to the true impact energy required to cause the fracture of the specimen. Item (*b*) is actually the shearing strength of the material and should not be considered as part of the impact strength. Energy (*a*) can be defined, for the purposes of this investigation, as the energy necessary to produce an incipient crack in the specimen. It can be safely assumed that under service conditions the smallest crack will destroy or limit serviceability of the molded piece. The ratios of the above energies vary greatly for different materials. For brittle materials items (*a*) and (*c*) are large while the shearing strength is low. For tough materials the shear is high and on high impact materials it may be as much as 80 per cent of the total Izod reading. Friction and vibration losses are relatively small. The kinetic energy of the broken ends varies with density. It can therefore be assumed that while the Izod machine is satisfactory for metals it is not applicable to plastics where the errors in using it may be over 90 per cent.

Since the impact strength is generally considered to be the most critical mechanical test for plastic materials, with many plastics being classified according to their impact strength, and since the present excess swing pendulum method of determining impact strength appears inadequate, a test method which would eliminate or reduce most of the errors inherent in the Izod machine appears definitely desirable.

The ideal method of testing impact strength of plastics would consist of a free drop of a weight upon the specimen supported *in vacuo*, thus eliminating all friction errors. The magnitude of the weight should be such that it would cause only an incipient crack in the specimen, eliminating the shearing and broken end errors (*b* and *c*). The vibration error, never a great one in plastic materials due to the natural damping effect of the material, can be further decreased by rigid clamping of the test specimen. Plastic deformation or compression of the specimen can be minimized by increasing the area of contact between the load and the specimen.

In an approach to the ideal condition described above, steel balls of different weights were dropped upon a specimen rigidly supported in a vise. Since the air friction on a spherical ball is a very small fraction of the total energy delivered, vacuum was not used for the test. Notched Izod specimens were used since these specimens were easily available in the Laboratory. The moment arm of 0.866 in., similar to that of the regular Izod test, was selected. The ball was made to fall on exactly the same spot for each specimen since the deviation of $^1/_{32}$ in. on the moment arm would introduce an error of over 3 per cent.

No mechanical means for dropping the ball was found suitable since the slightest rotation imparted to the ball resulted in scattering of individual drops. Balls dropped from an ordinary electromagnet also did not fall uniformly since the magnet did not demagnetize instantaneously when the current was cut off. A special electromagnet having a characteristic of almost an immediate demagnetization was therefore developed. A centering device was mounted on the tip of this magnet enabling the balls to be dropped with high accuracy. No appreciable scattering was observed with this setup.

Test Specimens

The Izod specimens used for this test were $^1/_2$ by $^1/_2$ by $2^1/_2$ in. long, with the notch milled in on the face of the specimen. Since the uniformity in the shape of the notch is considered to be an extremely important factor in impact strength determinations, all specimens used for tests were examined in a shadowgraph box, in which the image of the notch, multiplied 150 diameters, was projected onto

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the authors. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

* Revised copy of the Paper presented at the October, 1943, Meeting of Subcommittee VIII on Research of Committee D-20 on Plastics of American Society of Testing Materials.

The opinion or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large.

[1] Materials Engineers, Material Laboratory, Navy Yard, New York, N. Y.

[2] R. Burns, "Impact Fatigue Endurance Limit of Plastics," Experimental Records of Bell Telephone Laboratories, unpublished paper.

[3] David Telfair and Howard K. Nason, "Impact Testing of Plastics—I. Energy Considerations," *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 1211 (1943).

[4] L. H. Callender, "New Methods for Mechanical Testing of Plastics," *British Plastics*, Vol. 13, No. 155, pp. 445–458 (1942); also Vol. 18, No. 156, pp. 506–519 (1942).

a stencil marked with the proper notch angle and radius for this magnification. All specimens which did not conform closely to the shape of stencil were rejected.

Description of Apparatus

The machine consists of two parts—the basic machine or the determination of single-blow impact strength and an attachment for automatic impact fatigue testing (both are shown on Fig. 1).

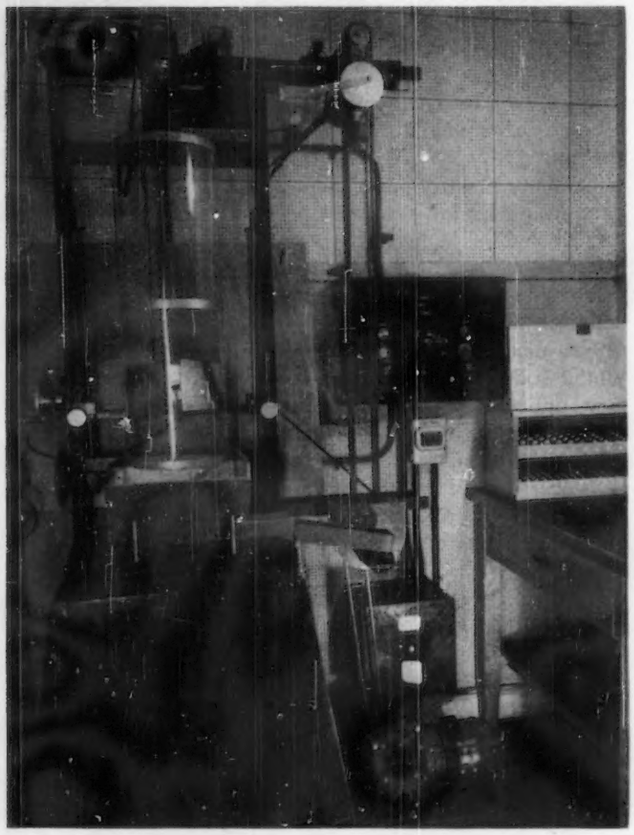


Fig. 1.—The Drop Ball Machine.

Single-Blow Impact Test:

The single-blow test consists of dropping hardened steel balls (ball bearings) from a selected height on to the specimen supported in a vise (Figs. 1 and 2). The balls are dropped from the special electromagnet and strike the sample 0.866 in. from the support. The specimen holder can be raised or lowered so that the height of the drop can be varied between 12 in. and 36 in. The magnet (Fig. 3) is mounted on a helical thread and can be moved up or

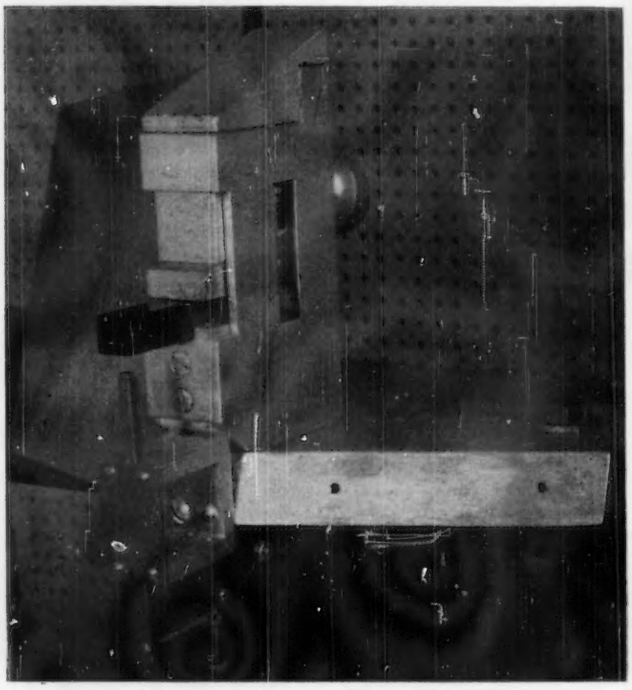


Fig. 2.—Drop Ball Machine Specimen Holder.

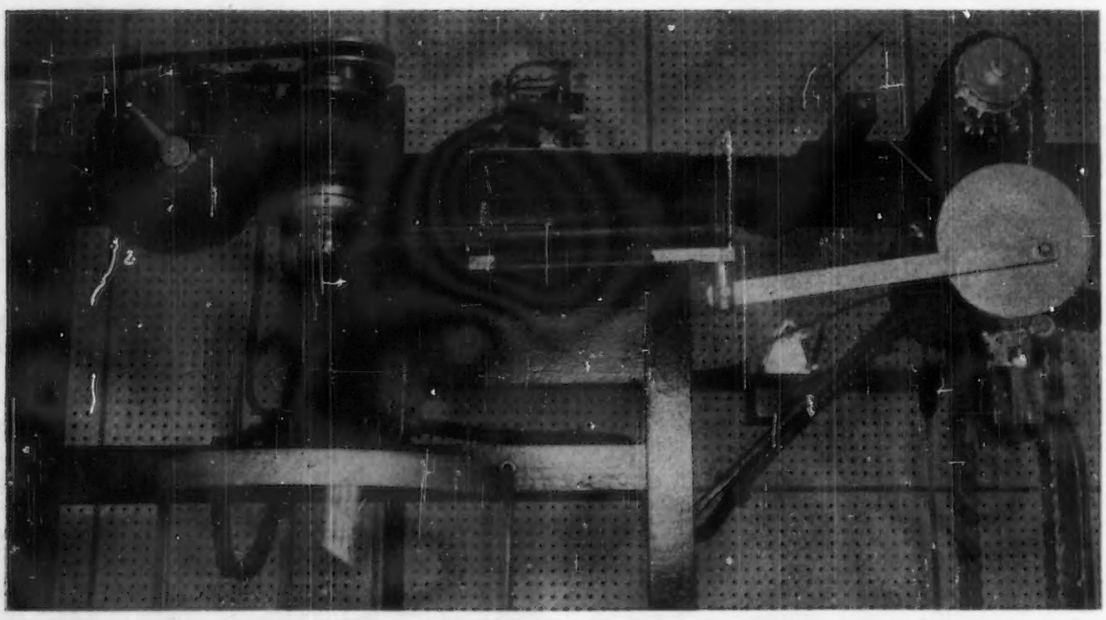


Fig. 3.—The Drop Ball Machine Magnet and Loading Mechanism.

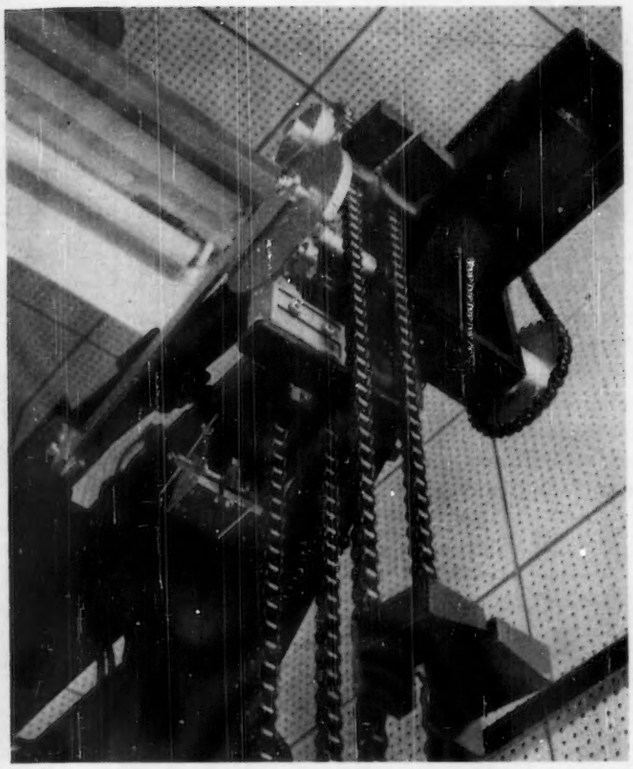


Fig. 4.—Drop Ball Machine Side View.

down so that when the specimen holder is adjusted for any height of drop, the magnet can be adjusted to keep this drop constant for any size of the ball. The balls used range from $1^1/_2$ in. in diameter to $^1/_2$ in. The $1^1/_2$-in. ball is the largest that can be conveniently used on an Izod specimen since the 0.866-in. distance from the center of the ball to the support definitely limits the maximum size of the ball. It was also found undesirable to use balls smaller than $^1/_2$ in. The balls from $^1/_2$-in diameter to 1-in. diameter increased in $^1/_{32}$-in. increments. Above 1-in. diameter the increments were $^1/_{16}$ in.

Multi-Blow Impact Fatigue Test:

The automatic impact fatigue fixture of the machine consists of a hopper in which the balls fall after striking the specimen. The bottom of the hopper is slanted and ends in a trough leading to the bottom of a vertical chain conveyor. The ball is picked up by a slotted conveyor bucket shown in Fig. 4. The bucket carries the ball past a counter arm which passes freely through the slot when the bucket is empty but is lifted and dropped, registering the counter, when there is a ball in the bucket. Near the top of the conveyor the ball is discharged by means of a stationary rod, mounted at 45 deg. to vertical, which passes through the slot in the bucket and pushes the ball out (see Fig. 3). The ball falls on a fixed inclined trough from which it rolls onto a slightly inclined moving trough connected to an excentric which pushes this trough under the magnet. The machine is so synchronized that the ball reaches the end of the moving trough at the same time that this end arrives under the magnet. The ball is now picked up by the magnet and the trough is pulled out of the way until the space under the magnet is clear. At this point the magnet current is automatically cut off and the ball falls on the specimen. The conveyor can be adjusted to deliver a ball every 4 to 10 sec. to the magnet. This time interval was chosen to prevent any error from heat effects since it is considered that it is sufficient to allow the specimen time to cool off.

An automatic cut-off consisting of a vertical rod connected to a micro-switch is mounted under the specimen as shown in Fig. 2. The space between the specimen and the top of the rod is adjusted so that any load short of breaking load will not deflect it sufficiently to touch the rod. When the sample is broken or cracked the deflection is greater and the specimen pushes down on the rod, which is moved from the micro-switch breaking the contact and stopping the machine.

METHOD OF TEST

Three methods of test were used with this machine.

Method I—Repeated Blow Method:

The first method consists of placing the specimen into the machine and dropping balls on it, starting with the smallest, until the specimen breaks. This tentatively locates the energy range in which the material belongs. After the range has been found, several sets of specimens are broken, using the same energy for each set, starting with the smallest ball that will just crack the specimen in one blow, and decreasing the size of balls until the specimen withstands a thousand or more blows. The average number of blows required to fracture the specimen for each ball is then plotted on log scale of semi-log graph paper against the impact energy. A curve is then drawn through these points. The point at which the curve intersects the one, or single-blow axis on the log scale is taken to be the single-blow strength. The energy at which the curve becomes asymptotic to the number of blows axis is the multiblow or fatigue strength. For the purpose of this investigation, the energy value at approximately 1000 blows was assumed to be the fatigue strength. Since for most of the materials tested the fatigue curve tended to approach horizontal at values between 1000 and 10,000 cycles, the errors resulting from the above assumption are relatively unimportant. It is recognized, of course, that the true ultimate fatigue limit probably does not occur below 10^5 or 10^6 cycles.[5] However, the energy change between 10^3 and 10^6 cycles is in most cases only a small fraction of the energy change between single blow and 1000 cycles.

Method II—Increased Blow Method:

This method is similar to that described by Telfair and Nason.[3] The specimen is struck by a ball somewhat smaller than that required to crack it in one blow, then the size of balls is increased until the specimen fails, each ball being dropped once. Values obtained by this method for single-blow strength are somewhat lower than those of the first method because of fatigue effects.

[5] William N. Findley and Otto E. Hintz, Jr., "The Relation Between Results of Repeated Blow Impact Tests and of Fatigue Tests," *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 1226 (1943).

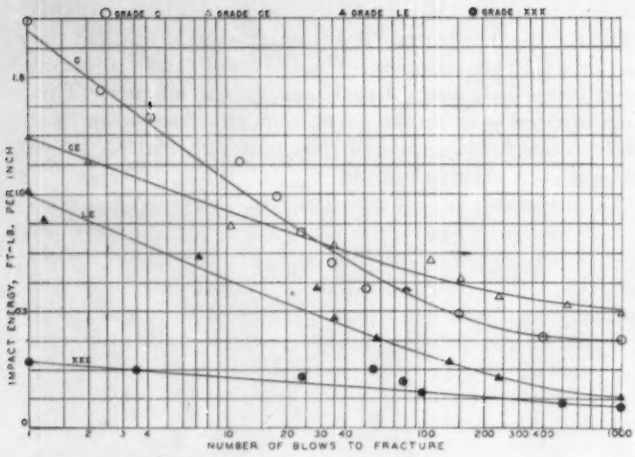


Fig. 5.—Impact Fatigue Curves for Laminated Phenolic Materials.

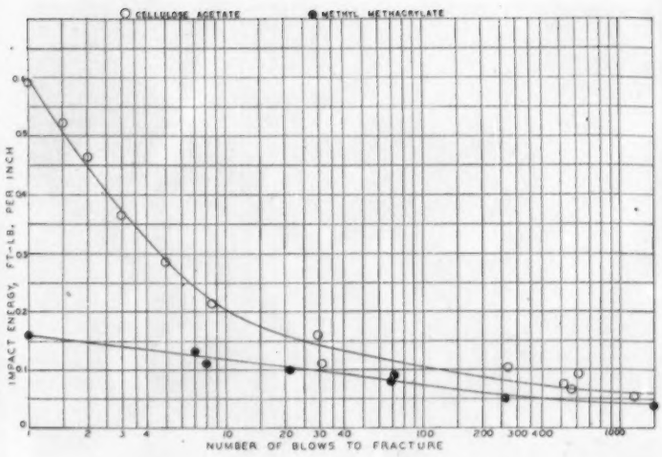


Fig. 7.—Impact Fatigue Curves for Cellulose Acetate and Methyl Methacrylate.

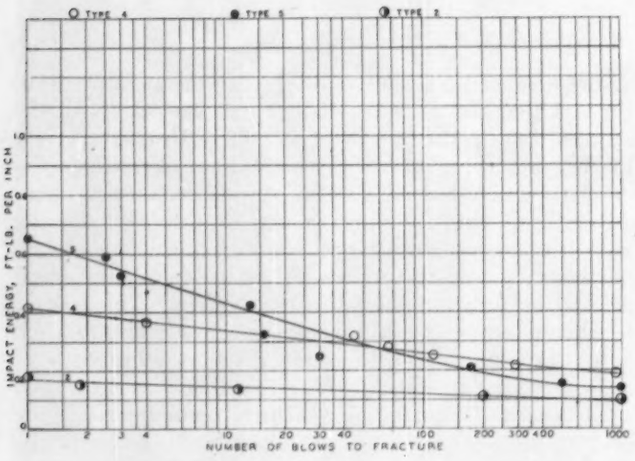


Fig. 6.—Impact Fatigue Curves for Molded Phenolic Materials.

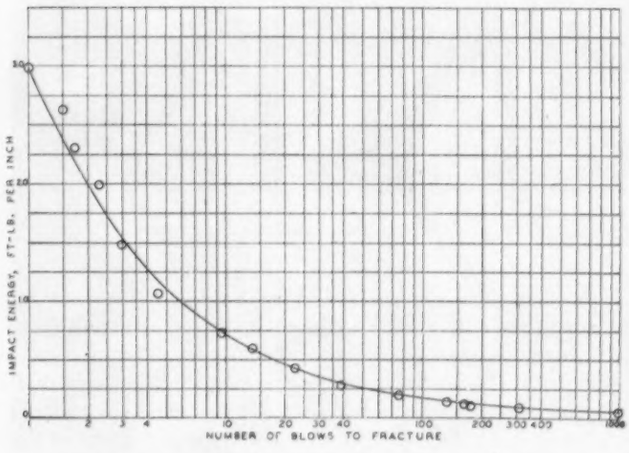


Fig. 8.—Impact Fatigue Curve for Ethyl Cellulose.

TABLE I.

Material	Drop, in.	Single-Blow Strength, ft-lb. per in.	Multi-Blow Strength, ft-lb. per in.	Endurance Factor, per cent	Izod Impact Strength, ft-lb. per in.	Cracked Izod Strength, ft-lb. per in.	Net Izod Strength, ft-lb. per in.
Laminated Phenolics[a]							
Grade C	36	1.76	0.43	24.4	4.86	4.38	0.48
Grade C	24	1.72	0.34	19.8	4.86	4.38	0.48
Grade LE	36	0.982	0.156	15.9	2.62	1.86	0.76
Grade CE-1	36	1.22	0.34	27.9	2.98	2.64	0.34
Grade CE-2	36	1.24	0.45	36.3	3.48	3.05	0.43
Grade XXX	36	0.285	0.095	33.3	1.98	1.87	0.11
Glass Fabric	36	3.00	0.100	3.3	20	20	...
Molded Phenolics[b]							
Type 2	24	0.168	0.102	60.7	0.381	0.320	0.061
	36	0.170	0.101	59.4	0.381	0.320	0.061
Alpha cellulose filled melamine	24	0.330	0.064	19.4	0.837	0.720	0.117
Type 4	36	0.398	0.150	37.7	1.39	1.11	0.28
Type 5	36	0.648	0.131	19.8	2.51	2.25	0.26
Type 6	36	0.726	Irregular	...	5.74	4.74	1.00
Type 10 mica-asbestos	24	0.073	...[c]	...	0.310	0.294	0.016
Type 9 asbestos	24	0.269	0.064	23.8	0.985	0.850	0.135
Type 7 mica	12	0.050	...	...	0.473	0.435	0.038
	24	0.046	...[c]	...	0.473	0.435	0.038
	36	0.044	...	...	0.473	0.435	0.038
Thermoplastics							
Cast acrylic resin	36	0.132	...	...	0.222	0.141	0.081
	24	0.158	0.042	25.4	0.222	0.141	0.081
	12	0.162	0.042	24.8	0.222	0.141	0.081
Cast polystyrene	12	0.20	<0.025	<12.5	0.242	0.218	0.024
Cast ethyl cellulose	36	2.98	0.073	2.45	4.80 to 3.20	Irregular	...
Cellulose acetate H-2	24	0.979	0.075	7.65	1.55	1.49	0.06
Cellulose acetate H-4	36 and 24	0.607	0.055	9.05	1.180	0.333	0.847
Cellulose aceto-butyrate	24	0.702	0.050	7.13	1.370	0.236	1.134

a Tentative Specifications for Laminated Thermosetting Materials (D 709 – 43 T), 1943 Supplement to Book of A.S.T.M. Standards, Part III, p. 313.
b Tentative Specifications for Phenolic Molding Compounds (D 700 – 43 T), *ibid.*, p. 280.
c The multi-blow strength is below the range of the machine.

Method III:

The third method is the statistical method where groups of specimens are subjected to single-blow impacts of the same ball for each group and the percentage of specimens fractured by each size ball is determined. This method also is applicable only to single-blow tests.

For the impact fatigue tests the heights of 12, 24, and 36 in. were used. The ranges of energies were 0.0184 ft-lb. to 0.498 ft-lb. for 12-in. drop, 0.0367 ft-lb. to 0.995 ft-lb. for 24-in. drop, and 0.0551 ft-lb. to 1.493 ft-lb. for 36-in. drop. It was attempted to test each material in the range where a complete fatigue curve could be drawn. Wherever possible duplicate tests were performed using two ranges.

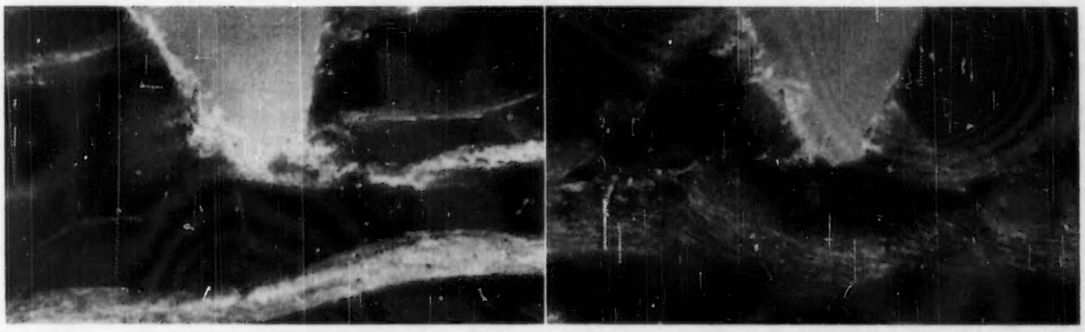
To correlate the data between the single-blow strengths as obtained by the two impact machines, the cracked specimens from the drop ball machine were placed into the Izod machine and broken. The indicated strength was then subtracted from the Izod strength of the unbroken specimens.

Endurance Factor

As mentioned above, the energy value at approximately 1000 blows was assumed to be the multi-blow strength. The ratio of this strength to the single-blow strength was called the endurance factor. The impact strength was calculated in foot-pounds per inch of notch.

Determination of the End Point

The impact energy as determined by this machine consists of the product of the height of drop in feet times the weight in pounds of the ball used to just cause the first crack in the material. This end point can be determined in several ways. On transparent and translucent materials the crack is readily visible to the eye as soon as it occurs. On opaque materials the crack may be found by observing the rebound of the ball and the "ring" of the specimen when hit by a ball. In many cases the ball rebound changes from almost vertical to an angle up to 45 deg. off vertical after the crack occurs. In most cases the impact at that time will also sound flat. Most specimens will



(*a*) Laminated glass fabrics (× 15). (*b*) Laminated canvas (× 15).

(*c*) Molded rag filler (× 15). (*d*) Molded mineral filler (× 12).

(*e*) Unfilled thermoplastic (× 30).

Fig. 9.—Typical End Points.

also deflect sufficiently after the first crack to trip the automatic stop. On repeated blow tests the height of rebound is also an indication of the crack. This is especially true for hard-tough materials. The rebound of the ball is also decreased after the specimen is cracked. When there is any doubt the specimen is removed from the machine and examined under a microscope. A few typical end points are shown on Fig. 9.

Results of Investigations

The combined data for all materials tested are presented below in a table form. All test specimens were conditioned for 96 hr. at 25 C. and 50 per cent relative humidity previous to test.

Discussion of Results

From Table I it can be seen that the relative ratios between single-blow strengths of different materials are quite different when determined by the Izod and the drop ball machines.

The relative ratios for laminated materials are:

Material	Drop Ball Machine	Izod Machine
Grade C	6	2.5
Grade LE	3	1.3
Grade CE-1	4.5	1.5
Grade CE-2	4.5	1.8
Grade XXX	1	1
Glass fabric	11	10

It is evident that grade C material, which is only 2.5 times as strong in impact on the Izod test as grade XXX material, is six times as shock resistant in the drop ball test. The other fabric materials are also relatively two to three times more shock resistant. The ratios between various fabric-base materials appear not to change appreciably regardless of which machine is used.

For molded materials the ratios are as follows:

Material	Drop Ball Machine	Izod Machine
Type 2	3	0.8
Alpha cellulose filled melamine	7	1.8
Type 4	8	3
Type 5	13	5
Type 6	15	12
Type 10	1.5	0.65
Type 9	5	2
Type 7	1	1

These data substantiate, in a general way, the theory discussed in paragraphs 3 and 4. The ratios between the mineral-filled and cellulose or rag-filled materials are quite different on both machines. Comparing type 2 and type 7 materials, the Izod strengths are approximately equal while on the drop ball machine type 2 is three times stronger. This latter ratio is supported by results of shock tests on finished parts molded from these materials. Type 10 asbestos-filled material appears to be much stronger in shock resistance than is indicated by its Izod strength. This would indicate that asbestos fibers, while relatively weak in shear, are able to withstand sudden impact stresses.

The curves, Figs. 5 through 8, show some of the plotted results of the fatigue tests performed upon various plastic materials. The single-blow and multi-blow strengths obtained from these curves are listed in Table I. From the examination of the above curves it appears that the curves for most materials tend to approach the horizontal axis at from 1000 to 10,000 blows. The multi-blow values listed in Table I were determined by taking the value of the horizontal section of the curve or by estimating in cases where the curve did not appear to approach the horizontal at 1000 blows.

With the exception of glass fabric base material, the endurance factor of laminated materials varied between 16 and 30 per cent. Glass fabric base material has a very high Izod impact strength compared to other plastics and is very tough and apparently has good shock resistance. When tested on the drop ball machine, however, it requires only a small amount of energy to crack it in a few hundred blows. The endurance factor is only 3.3 per cent and therefore this particular material is unsuitable for applications requiring repeated shock resistance.

For molded thermosetting materials the endurance factor is highest for type 2 where the range between the single-blow and multi-blow energy is small. The endurance factors and the fatigue curves of other molded materials are similar to those of laminated materials. It was noted that when the impact energy to crack is plotted on semi-log paper against the number of blows, the resulting relationship for thermosetting materials is usually a straight line up to several hundred blows.

The fatigue curves of brittle thermoplastic materials such as methacrylate and polystyrene are similar in shape to those of thermosetting materials. Ethyl cellulose and cellulose acetates, however, have a much smaller straight-line portion, and appear to reach their limit in a smaller number of blows. The latter materials show a distinctly tough fracture.

Types of Fractures

On Fig. 9 are shown some of the few typical end points. The crack on the laminated glass and canvas fabric base materials occurs in a plane parallel to the surface, that is, in the plane of maximum tensile stress. The fibers in this case are stronger than the resin bond and the resin breaks between layers for canvas and between glass and resin for glass fabric. The breaks on molded materials, where there are no distinct laminae, occur at approximately 45 deg. to the face of the specimen. This is a definite *brittle-tough* fracture. The unfilled thermoplastic (methacrylate) has a pure brittle fracture which occurs in a plane perpendicular to the surface. Slightly different magnifications were used for these photomicrographs and are listed under each material in diameters.

Conclusion

It appears from the above that the drop ball impact test method is more applicable and more accurate than the Izod excess swing pendulum for impact strength determinations. Most of the errors inherent in the Izod machine are eliminated or reduced to a minimum using the drop ball method.

The impact fatigue strength of plastics as determined by the latter method is a reliable indication of the actual working stress of the material. The fatigue curves also provide a convenient method of predicting the behavior of plastic materials in service.

Acknowledgment:

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Metallography in Color*

By R. P. Loveland[1]

EDITOR'S NOTE.—Knowing that the development of the system and technique described in the accompanying paper, and the reproductions of the color photomicrographs were outstanding achievements, we asked the Chairman of Committee E-4 on Metallography to prepare an introductory Note which follows.

Introduction

By L. L. Wyman, Chairman,
A.S.T.M. Committee E-4 on Metallography

The application of color photography to photomicrographic work is proving to be another major advance in microscopic technique. Although originally presented to the Society nearly two years ago, the publication of this excellent paper on color photography and its application to metallography has been withheld pending the conclusion of the most recent developments in this field.

Color effects have long been used by metallographers for such identification as inclusions, segregate phases and diffusion zones; later developments in the application and use of polarized light greatly enlarged the scope of these identification methods by providing a greater range of coverage as well as more positive determination. As shown in the comprehensive paper by Mr. Loveland, modern technique is further aided by color photography and printing.

One has but to examine the reproductions of Mr. Loveland's color prints in order to realize not only the potentialities offered by the use of polarized light, color tinting and the like, but also the availability of convenient methods of permanently recording these effects which so greatly aid modern metallographic analysis.

ALL PHOTOGRAPHS in full color are made by one of the so-called three-color processes. In each case, the first step is to make three negatives by the blue, green, and red components of the light from the subject. This is done by exposing the films or plates through *primary color* filters of blue, green, and red. The negatives made in this way are called, respectively, the blue filter negative, the green filter negative, and the red filter negative (Fig. 1). A positive print is then made from each filter negative, either by printing in the normal manner or by photographic reversal of the negative.

In the *additive processes*, the black-and-white positives are projected or viewed simultaneously through the filters by which their corresponding negatives were made. In the *subtractive processes*, the positives are made into colored positives having colors which are complementary to those by which their respective negatives were made. These colors are called the subtractive primaries; that is, yellow (minus blue); magenta (minus green); and cyan (minus red). These colored positives are superimposed in register to obtain the color picture.

In all full-color processes, at least three separate pictures are made and viewed in register. The steps may be accomplished in many ways, and there are, therefore, many different types of color process.

The most common additive process is that known as the screen plate (or film) process.[2] In it, the film or plate is coated with minute blue, green, and red filter units, so that the three primary color pictures are present but broken up into fine elements that are intermingled. It is developed by reversal and viewed through the minute filters to give a color transparency.

The oldest method in subtractive color photography, and one still in use, is to make the three color prints on thin transparent tissues and then to superimpose them in register on some support. In the so-called Carbro process, the three colored positives are made in pigmented gelatin and are superimposed on a white paper support to give a paper print.

A very satisfactory method is to convert the original colored prints to matrices from which the ink or dye of the colored images may be transferred successively in register to a suitable support, such as paper. This is the method used by the Kodak Wash-Off Relief process for making paper prints. Each print, used as a positive matrix, has an image of hardened gelatin in relief; the paper contains a mordanted gelatin coating which imbibes the dye from each matrix.

One of the most recent methods employs a film which is coated with the three separate photographic emulsions in superimposed layers, all within the thickness of a usual film coating (Fig. 2). The emulsion layers respond to blue, green, and red light, respectively, although a yellow filter is incorporated to protect the green- and red-sensitive layers from the blue light to which all photographic emulsions are sensitive. Such a film is designated as an *integral tripack* and is exemplified by Kodachrome and Kodacolor films. The entire film may first be developed in the usual manner to give the three superposed filter negatives, as is done with Kodachrome film, and the three colors, yellow, magenta, and cyan are introduced into the appropriate picture layers when the film is reversed to a positive. The colors are formed by *coupler development*. In this, the oxidation product of the developer combines with compounds called *couplers*, carried in with the developer to form the three insoluble dyes. It is necessary, of course, to perform the processing so that the dye formed in each layer is complementary to the color of the light which originally exposed it in the camera.

On the other hand, the couplers may be incorporated in the photographic emulsion layers during manufacture, as is the case with Kodacolor film, in which each coupler is carried as small particles of dispersed organic material. This material prevents reaction of the coupler with the photographic emulsion but dissolves the oxidation prod-

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NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

*Communication No. 964 from the Kodak Research Laboratories.

[1] Eastman Kodak Co., Rochester, N.Y.

[2] For detailed directions of the application of the Dufay process to metallography, see reference (*1*) at the end of this paper.

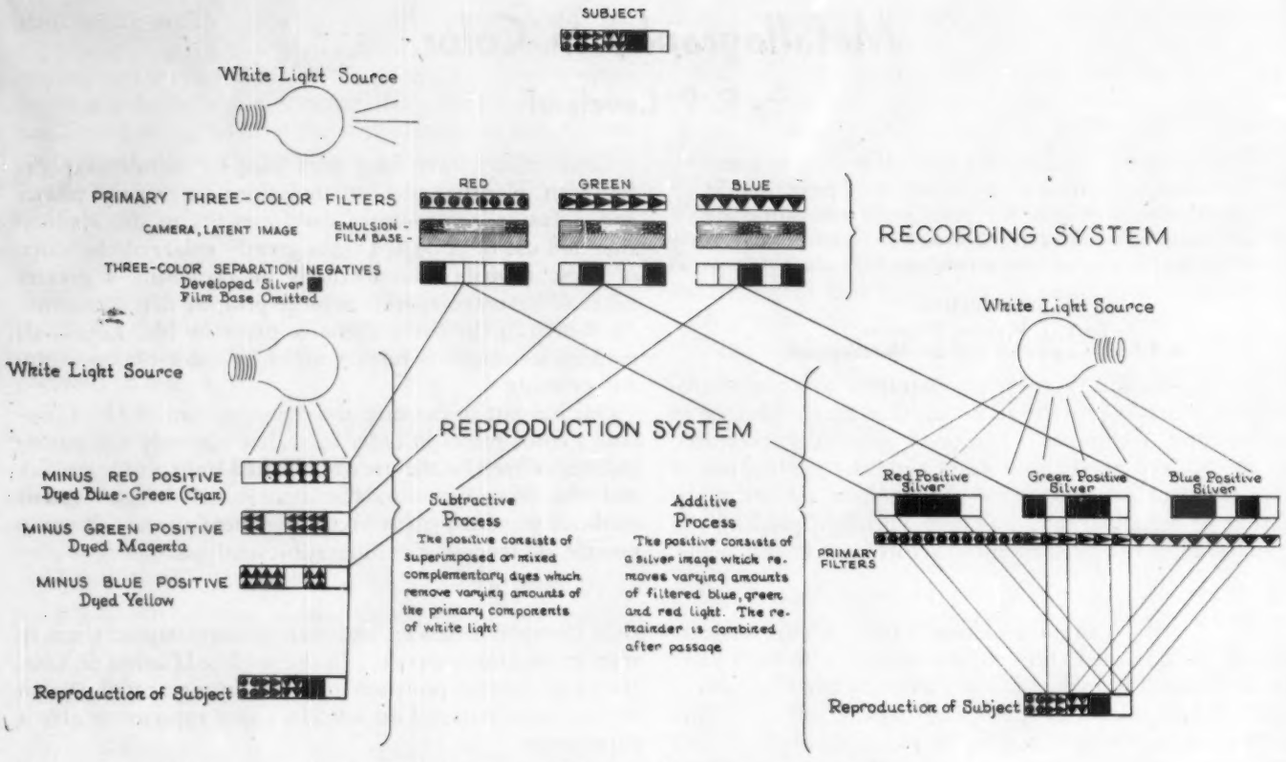

Fig. 1.—Schematic Diagram of Three-Color Photography.

ucts of the developer so that the colored elements of the final image are formed in this dispersed phase. This is called the *protected coupler process*.

Practical Classification:

In discussing the problems of color photography from the standpoint of the user of these methods, it is perhaps simplest to classify them as (1) the *separation negative method*, (2) *screen plate processes*, or (3) *integral tripack processes*. In the last two methods, a single exposure takes the three pictures simultaneously on one film or plate. Since the three images are formed in three inseparable layers, there are no problems of registration. The absence of pattern in the third type of process is a decided advantage. The advantages of such single-exposure materials are: simplicity in use, and convenience and speed in taking the picture. Because of the last-named advantage, they are often the only materials that can be used where the subject is moving or unstable. This does not usually apply to photomicrography, however, where the specimen can be expected to remain stable and in position for an indefinite period.

Separation Negative Method

Under this heading come all of the cases where the color filter negatives are made on separate films or plates. They may be exposed separately or simultaneously, as in a so-called "one-shot" camera, which splits up the original image beam by partial mirrors and sends one fraction to each film. A bipack of two films pressed emulsion to emulsion and each sensitive to a different color may be used instead of two of the separated films. Such a camera has no advantage in metallography, since it sacrifices the freedom available in separately exposed negatives for no adequate gain.

We shall consider, then, only the cases where the filter negatives have been separately exposed and are separately printed. As mentioned before, the prints must be either colored, so as to be complementary in color to the taking filter, or used as matrices to form colored prints. In each case, each image is superimposed in register.

Potential Accuracy of Separation Negative Method:

The separation negative method is the oldest method but is capable of accurate color reproduction. In the first place, it offers the greatest degree of freedom. With a continuous source, such as the incandescent tungsten or carbon arc lamps used for illumination, any reasonable variation in the quality of the illumination can be com-

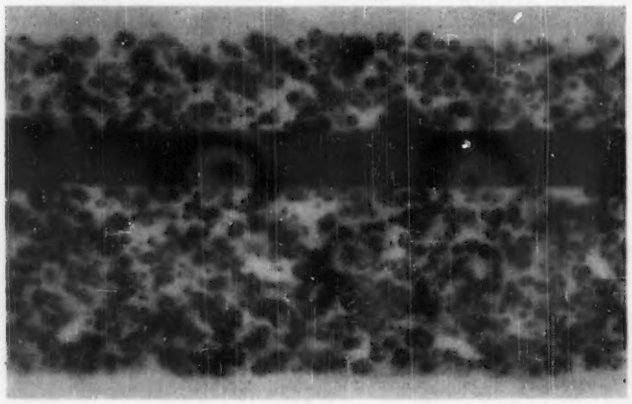

Fig. 2.—Cross-Section of Emulsion Layer of Kodachrome Film (×2500).

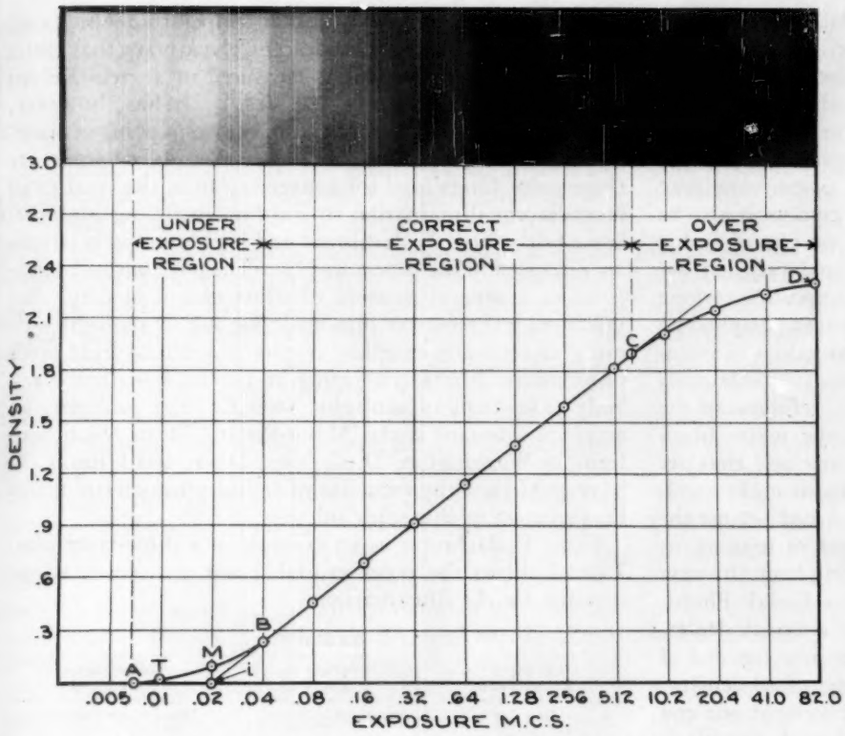

Fig. 3.—Characteristic Curve of a Photographic Material.

pensated for by merely altering the relative exposures through the color filters. There is even greater possibility of control in the processing by this method, since each print can be reworked or remade until it fits its component part in the color balance almost perfectly. This may be expensive in time and labor, but it is not a hit-or-miss method depending only on the judgment of the operator, for a positive control exists in the form of the scale of gray tones such as that shown at the top of Fig. 3. In studio work, such a scale is usually placed within the camera field near one edge so that it can be cut out later. If there has been no local distortion in exposure or processing, the whole picture will be in the best color balance for the filters and dyes in use when this gray scale is correctly reproduced by the three colored component images. Moreover, it is possible to distinguish whether a fault lies in the print or a negative. The scales on each of the negatives should be identical, although differences can be compensated for in printing. In the finished colored print, if the scale differs from gray by a uniform hue, at least one of the three prints was incorrectly exposed. If the color changes along the scale, the three prints do not all have the same contrast. When there is a great amount of this work to be done, or when the method[3] is being resorted to in order to obtain very accurate results, a densitometer should be used. With this instrument, it is possible to measure accurately the steps of the three reproduced scales and to plot them against the relative exposures that were given each step; for example, each step of the original scale may have given one half of the exposure allowed by the previous step. The result is a characteristic curve, similar to that of Fig. 3, for each reproduced scale. In this case the abscissa is in logarithmic units of meter-candle-seconds. From these curves the exact correction can be determined. The colored scales on each component print can be measured as gray scales by measuring them through their complementary color filters.

Correction of Dye or Pigment Defects:

Finally, the applicability of the *masking method* (*4*)[4] increases further the possibility of accurate color reproduction of the separation negative method of color photography. It consists, in general, of interposing one or two preliminary prints of low contrast in front of the negative in printing each of the final colored positive prints. The masking print is made through a color filter chosen according to the color whose contrast in certain details it is desired to control. Its principles and advantages call for more explanation than can be given here. Briefly, there are no colored pigments or dyes actually available for making the three-colored components of a picture that do not absorb light outside of their own spectral domain and thus degrade the hues of the final result. For this reason, in color photoengraving, the engraver makes local adjustments of the etching of his copper plates until he has compensated, at least partially, for the departure of his inks from their ideal colors. His local etchant in effect subtracts the excess density of one component of a color in a certain area. A purely photographic method of doing this has been devised that is applicable to all color photography by separation negatives (*4*).

Theoretically, with dyes or pigments that are actually available, the masking method should always be used in the subtractive process of color photography, for, with its complete application, the same result should be obtained as if the ideal coloring matters were available. In practice, its improvements may not be particularly noticeable if there are no highly saturated colors present in the picture; but if there are, its results are sometimes startling. It is usually needed, therefore, for the photomicrography of stained specimens. In metallography, it may not be needed, although it is required for good reproduction of intense polarization colors of higher order than the first. It is probably not practical to employ the masking method without adequate means for sensitometric control, that is, without the gray scale and densitometer.

Use of a Gray Scale in Metallography:

The photomicrographer usually cannot insert a gray scale, such as that shown at the top of Fig. 3, in the picture area, as can the studio photographer, and the question of the best substitute procedure is frequently asked. Obvi-

[3] Details of the separation negative method can be obtained from references 2, 3, and 4 at the end of this paper.

[4] The italic numbers in parentheses refer to the reports and papers appearing in the list of references appended to this paper.

ously, the only practical solution is to place the gray scale on each negative by a separate exposure, even though it must have the same characteristics as those actually in the microscopic field. This means that it should have the same quality of illumination as the picture; the filters and filter factors that are used must be the same for the exposure, both to the subject and to the accompanying gray scale. The actual exposure times of the two must also be of the same order, since the behavior of photographic plates and films with respect to speed and contrast are somewhat different when given *equivalent* exposures (where exposure equals the intensity of illumination multiplied by the time of exposure) but at very different values of intensity (*5*, *6*). To accomplish this entails considerable extra trouble, but it is worth it because of the usefulness of the gray scale control. In the first place, the matte black paper separators that are cut to correct size and that are included in boxes of unexposed film and paper make excellent material for masks and can safely be placed against the surface of a fast emulsion without danger of fogging it. A transparent gray scale, each step differing from the next by a density of 0.3, should be made or a Kodak Photographic Step Tablet can be obtained from a Kodak dealer. This should be placed in the plate holder near one end of the plate or film leaving one step area clear of all density. All of the surface of the film, except the strip at one end used by the step wedge, can be covered with the black paper. After exposure of the control strip, this exposed end strip is covered with black paper and the rest of the plate or film exposed to the picture image. The material is processed as usual.

In photomicrography by transparent illumination, the control strip can be exposed to the illumination at the back of the camera with the specimen racked out of the way and with the plate holder set only halfway down into position so that the gray step wedge over the end of the photographic plate lies in the middle of the illuminated field. In metallography, the light beam must be reflected from some specimen, but a first surface mirror can be used for this purpose. Aluminum is the only common metal, including silver, that has practically equal reflectivity at all wave lengths throughout the visible spectrum and even beyond it at both ends. Therefore, an aluminum mirror should be used. If it is desired to read the strips with a densitometer and to use sensitometric control, extremely uniform illumination across the photomicrographic field is essential.

Integral Tripack Processes

Granting that the separation negative method is the most accurate for very critical work, can the advantages of the three-layer film be utilized in metallography? The fact that the three pictures are taken simultaneously means that the exposure factors for the three filter negatives are predetermined in the manufacture of the film, and hence the quality of the illumination that gives correct results with the film is predetermined also. Anyone using these methods with other than the light sources usually specified, as does the metallographer, should become familiar with the term and concept used in specifying illumination quality, namely, *color temperature*. This term from pyrometry is already a familiar one to metallurgists as the optical measure of high temperature, that is, the color temperature of a glowing body is that temperature which corresponds to that of an incandescent black body that emits light of similar color. It is measured in degrees Kelvin (deg. K. = deg. Cent. + 273 deg.). It has, however, been developed considerably from the standpoint of specification of illumination quality. *Photometric filters* are those color filters used for converting from one quality of incandescent illumination to another, including sunlight. Some fairly recently developed and highly useful relations are discussed in the literature (*7*). The term has its limitations as a general measure of illumination quality; for instance, a three-layer film made for use in sunlight will not give critically excellent results in artificial light with photometric filters converting it to the so-called black body equivalent of sunlight, 5400 K. For sunlight, an accepted standard is the Abbot-Priest "Mean Noon Sunlight in Washington, D. C." and Davis and Gibson (*8*) have published the formulas of liquid photometric filters that convert to this standard.

Using Kodachrome as an example of a three-layer film, Table I shows the types available and the specifications required for the illumination.

TABLE I.

Type of Kodachrome	Made for Use with	Illumination Standard
Regular.....	Sunlight	Mean noon sunlight at Washington, D. C.
Type A.....	Photoflood lamps	3450 K.
Type B.....	Mazda lamps 3200 K.	3200 K.

Special emphasis is needed on the precision that is required in the standards of illumination quality since the range of tolerance of incorrect illumination varies so widely with both the nature of the subject and the requirements at the time. If there is no third color present, particularly if there is no blue, or if the third color is relatively unimportant, the quality of illumination required is usually not very critical. In this case, it is often possible to use a lamp of a type that cannot usually be recommended, such as the tungsten arc, or to allow the current through an incandescent tungsten bulb to depart appreciably from the amperage that is required to produce the correct color temperature for Type A or B Kodachrome film. This case includes a surprisingly large fraction of all the cases of color photomicrography. It must be remembered, however, that the presence of much gray, or of a gray in an important part of the picture, must be considered as equivalent to the presence of the three vivid colors that are balanced in its makeup. It is for this reason that the accurate reproduction of neutral grays is one of the most difficult problems for any process that can also reproduce vivid colors. In fact, the frequent presence of metallic grays to be reproduced is one of the chief problems in colored metallography. The question that should first be answered is: Will it be satisfactory to display the distinctions within the specimen or *must* the hues be well reproduced? The latter may be necessary in order to identify the inclusions. There is an enormous difference in the requirements for photography.

Selection of Illumination Quality for Metallography

The direct-current carbon arc is peculiarly suitable for photomicrography with Kodachrome film or any three-layer material. Fortunately for this purpose, it is the

light source that is most frequently included in metallographic outfits and metallographers are accustomed to using it.

The Carbon Arc as a Source of Reproducible Quality:

In the first place, the spectral quality of the light from the pure carbon arc is much more reproducible in any laboratory than that from incandescent tungsten; only with the arc will the same illumination quality (color temperature) be obtained for a given voltage and amperage through the lamp, irrespective of the make of the lamp. In fact, Chaney, Hamister, and Glass recommended (*9*) the direct-current carbon arc as a standard of color temperature for pyrometry, since the latter is hardly affected by the current through the arc when burned at a high current density, that is, with a high current per square millimeter of crater surface. The optimum is the highest possible current for the size of carbon before the arc becomes unsteady. Under these conditions, also, the arc is much less affected by slight cooling drafts and hence by the extent to which it is enclosed. Although the $4^1/_2$- or 5-amp. d-c. arc with 8-mm. anode is the most common of the metallographic arcs, decreasing the anode diameter for this same current to 6 mm. as in one arc or increasing the current for this same 8-mm. diameter to 10 amp. as in a new automatic arc are both very appreciable improvements in this respect. For instance, a change of 1 amp. with the 10-amp. arc produces less than half the difference in color temperature than with the 5-amp. arc and the same 8-mm. carbon anode.

The Spectral Quality of the Arc:

The arc cored only with carbon gives an illumination that has excellent black-body distribution except for an excess of ultraviolet caused by the formation of cyanogen. This can be seen from the graph (Fig. 4) published by H. G. MacPherson (*10*).

The analogous graph from the relatively new type of tungsten arc unfortunately would show the spectral lines from the mercury vapor, that is used to start the arc, rising in the visible region (λ400 to λ700 mμ) above the continuous curve in the graph which represents the spectral distribution of the incandescent tungsten, so this arc cannot be considered as satisfactory for the purpose. In general, a mixed or discontinuous source of illumination is not satisfactory for color photography. A compensating filter for the tungsten arc that again restores the neutral gray balance with Type B Kodachrome film was made by using a Wratten No. 2A filter plus a 2-mm. thickness of Corning didymium glass (No. 5120 filter). However, with this type of compensation the mercury lines which are still present will certainly give trouble with some specimens.

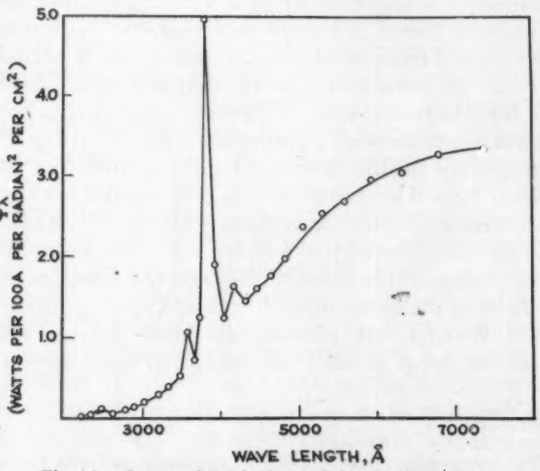

Fig. 4.—Spectral Emission of the Carbon Arc.

In metallography, the incandescent carbon anode is imaged in the objective field or aperture. Whereas, the excess radiation below λ400 mμ emanates from the arc stream, the core must be viewed through it and the core image, therefore, should then be a bluer white. The photographic effect of the presence of the glowing arc stream in the optical path must be even greater unless a filter absorbing these short wave lengths is in use.

An investigation was made to ascertain whether the unusually excellent black-body characteristics of the pure carbon arc, outside of the spectral region from λ340 mμ to λ430 mμ, could be utilized in converting the illumination to the proper color temperature for the various types of Kodachrome film and also to determine the "effective temperature" of the carbon arc at the various current densities in use in commercial equipment for Kodachrome film.

One method for accomplishing this obviously involves a filter that would just absorb the excess ultraviolet radiation, leaving the fraction corresponding to the normal component for the particular color temperature. It was found possible to measure the effect of that portion of the arc light above λ440 mμ since the cyan and magenta components of Kodachrome are only affected by this portion of the spectrum. It was also found that a 10-mm. layer of 20 to 25 per cent (by volume) sodium nitrite solution is a filter that just removes the *excess* ultraviolet from the arc light as measured by the results on Kodachrome film and leaves the normal amount that corresponds to the rest of the black-body spectrum. The resulting spectral distribution of the residual ultraviolet is not identical with that of a black body. The practical advantage of the filter of this precise concentration proved to be small, however, since even if the arc light were corrected to perfect black-body illumination, there are no photometric filters that are correct photographically, that is, that include the ultraviolet absorption spectrum.

It is well recognized (*10*) that specification of the quality of carbon arc illumination as a color temperature is not a simple matter, and it was found, as might be expected from consideration of Fig. 4, to be even more difficult when considered from the viewpoint of its photographic effect on a color film. We refer only to the carbon electrodes cored with amorphous carbon that are normally furnished for metallography and not to special carbons, such as the "white-flame" type sometimes recommended for photomicrography in color. Their case is even more complex and they are not suitable for use in photomicrography.

Considering the results of the carbon arc light on Kodachrome film independently from the effect on the ultraviolet and blue-sensitive yellow layer whose exposure is separately adjusted by filters, as discussed below, it was found, surprisingly enough, that the color temperature of the unfiltered arc as visually determined was a better measure of its quality than a curve, such as Fig. 4, that had been spectrophotometrically determined. Therefore, the values of the color temperature of the carbon arcs most frequently

used in metallography are given in Table II. They must be considered as approximations to the "effective color temperature" of the arcs for Kodachrome film. They were measured[5] using a colorless achromatic condenser to image the crater of the electrodes which were cored with amorphous carbon as usually supplied for metallography. The carbon core has a very slightly lower color temperature than that of the whole crater.

TABLE II.

Amperes	Anode Diameter, mm.	Color Temperature, deg. Kelvin
4½ d. c.	8	3645
5 d. c.	8	3680
5 d. c.	6	3750
10 d. c.	8	3820
10 a. c.	6.4–6.4	3475

Although an accurate value for the "effective color temperature" of the carbon arc for Kodachrome film was found to be unobtainable in practice, it was also found to be relatively unimportant, as will become evident. The reproducibility of the carbon arc, however, remains of very practical importance and is the chief value of this illuminant in color photomicrography.

Simple Correction of the Carbon Arc for Kodachrome Photography:

An ultraviolet-absorbing filter should always be used with a carbon arc when it is used for color metallography. A liquid filter of sodium nitrite ($NaNO_2$) solution is stable and very suitable in many cases, although a solid filter absorbing all of the ultraviolet is frequently more convenient, as will be discussed later. The absorption band of sodium nitrite is at only a slightly shorter wave length than the principal emission due to cyanogen and can be used to absorb it. In strong solutions the nitrite absorbs all radiation below about $\lambda 400$ mμ.

Even when the excess of ultraviolet radiation is just removed by such a filter, it is apparent from Table II that the color temperatures of the metallographic carbon arcs are not correct for direct use with Professional Kodachrome sheet film which is the most suitable type for metallography. Film of this type may be obtained either for use with sunlight or light from tungsten lamps burned at 3200 K.

The Davis-Gibson liquid filter (*8*) No. 18 is designed to convert illumination from a black-body color temperature of 3800 K. to that of mean noon sunlight. According to Table II, this should be useful with the 10-amp. d-c. arc, using an 8-mm. carbon anode for photomicrography with daylight-type Kodachrome film. In some cases, especially at very low magnifications, good results are obtained with this combination when the ultraviolet radiation is properly balanced with a suitable nitrite filter.

No sufficiently deep gelatin filter can be recommended, however, for use with this arc lamp. None of the commercially available glass photometric filters is sufficiently accurate to give good results when substituted for the corresponding Davis-Gibson filter. The Davis-Gibson filters are two-solution liquid filters that are made up from inorganic salts and so are generally available; liquid filters are satisfactory for a photomicrographic bench. They require two independent glass absorption cells since the two solutions are incompatible. The stock solutions for these filters must be made up carefully with analytical precision and stored in the dark in Pyrex containers. In practice, although these filters remain our standard when daylight-type Kodachrome film is used, it is more convenient to use the less accurate glass photometric filter with a correcting filter for it.[6]

By the same criterion, the Davis-Gibson filter (*8*) No. 15, which converts from 3500 K. to mean noon sunlight, should be the proper filter to use with the 10-amp. a-c. arc and the Davis-Gibson No. 17 (3700 K. to mean noon sunlight) for the common 5-amp. d-c. arc with daylight-type Kodachrome film.

Instead of raising the color temperature of the arc illumination, however, for use with daylight-type film, it can be reduced to 3200 K. and Type B Kodachrome film used with it. This would require an amber rather than a bluish photometric filter.

Use of Tungsten Lamps:

The fundamental unsuitability for metallography in color of the otherwise excellent tungsten arc has been discussed and a provisional expedient described for its use with Kodachrome film.[7]

Incandescent tungsten filament lamps are also used for metallography although the exposures are much longer than they are with an arc. They can be used for metallography in color; in fact, Types A and B Kodachrome films are made with the expectation that they would be used with incandescent tungsten lamps.[8] The chief difficulty, particularly in photomicrography where the illumination comes from a single lamp, such as a ribbon filament, is due to the facts that they cannot be depended upon to reproduce the same color temperature from lamp to lamp even when burned at the same amperage, and that there is an appreciable change of quality with age at a given amperage which is absent in the carbon arc. Therefore, some method of determining their color temperature is necessary, unless individually calibrated lamps can be obtained. In some metallurgical laboratories a suitable pyrometer may be available. A simple, practicable instrument (*11*)[9] for this purpose is based on the measurement of the ratio of the two separated wave lengths (of green and red) when the whole spectral distribution remains that of an incandescent black body. The color temperature of the illumination is read directly from a dial on the instrument.

Tungsten lamps normally provided for photomicrography would have an abnormally short life if burned directly at the color temperatures that are correct for Type A or B Kodachrome film. Therefore, they should be used at normal current with a photometric filter. An excellent technique for the use of such a lamp is as follows:

When Type B Kodachrome film is to be used, set the dial of an Eastman Color Temperature Meter at 3200 K. and view the lamp through a Wratten 78C photometric filter, while changing the current through the lamp until the two fields of the meter are equal. For Type A Kodachrome film, a Wratten 78B photometric filter should be used. When the lamp is used for metallography with these

[5] By the kindness of Mr. K. S. Weaver of the Kodak Research Laboratories.

[6] See p. 27.

[7] See p. 23.

[8] See p. 22.

[9] This instrument is now supplied by the Eastman Kodak Co. as the Eastman Color Temperature Meter.

filters and at the current determined in this manner, it will probably give weeks of satisfactory use but it must be checked occasionally for the effect of age on illumination quality. A new lamp should be aged by burning a few hours before calibration since the greatest rate of change occurs initially.

Several factors combine to limit the usefulness of the simple and calculable application of a photometric filter in modifying a light source for Kodachrome metallography and to force more empirical determinations of the proper modifying color filter. They are: (1) the difficulty in determining a "true" color temperature of a carbon arc, just discussed; (2) the lack of photographically correct photometric filters, as mentioned previously; and (3) a complication that may be considered as problem number two in metallography.

Effect of the Optics of the Illumination System:

To illustrate the second major problem in color metallography, let us consider first the color photography of an ordinary subject by an integral tripack process. Either a film made for use in sunlight is employed, or a lamp is chosen that will give the correct quality of illumination for a particular film. In each case, the sun or the light bulb is merely allowed to shine directly on the subject and the film is exposed. In photomicrography, however, an optical system is interposed between the light source and the subject. For equally satisfactory results, either the optics must not change the quality of the illumination or, if they do, the change must be compensated for.

In metallography, the microscope objective is also the illumination condenser so this lens will have better chromatic correction than the usual substage condenser for photomicrography by transmitted light, especially if apochromatic objectives are used, as they properly should be. However, the lamp condenser is usually an *f*/1 lens with absolutely no chromatic correction. If a Kodachrome film is first exposed directly to a light source with no intervening lens and then another picture is taken through some lens of the type that is usually used, such as an *f*/1, 60-mm. aspheric condenser, the second picture does not match the first, nor can it be made to do so accurately by any variation of the current through the lamp. When an *achromatic* lens, also *f*/1, 60-mm., is substituted for the uncorrected condenser, the picture again matches the Kodachrome transparency obtained with the light source alone. The same result is obtained, in effect, if pictures taken through the whole photomicrographic system are considered. Some of this difference is undoubtedly due to the fact that the simpler lens may be made of cheaper glass having a greater absorption in the near ultraviolet region. Some of it, however, is due to the change in the spectral quality of the illumination incident on the specimen because of the optical aberrations of a completely uncorrected lens of this large aperture. We were able to set up a metallographic system that was chromatically corrected throughout, consisting of the achromatic *f*/1 condenser noted above, with a 48-mm. Micro-Tessar lens replacing the simple lens usually used in the vertical illuminator and with no metal reflector in the system except the specimen. This was equivalent to the simpler, general optics in the illumination system.

No matter what the cause of the degradation of the illumination upon the specimen by intervening optics, if it is constant, it is obvious that it could be corrected by a suitable color filter. This is obviously a cheaper method of solving the problem than to build up a "perfect" optical system.

Effect of Ultraviolet Radiation and Its Removal:

Kodachrome film is balanced so as to utilize the near ultraviolet radiation in the spectrum of the illuminant. This will affect the top layer of the film only and act as one factor in building up the blue component of the picture. Conversely, its removal or partial removal will tend to make the picture yellow or brown. In general photography this effect is not usually objectionable, but in metallography it may be very troublesome. The removal of ultraviolet radiation can be a variable factor without its being visibly predictable. Different glasses in lens components act very differently as ultraviolet filters. The fluorite in almost all apochromatic objectives and most objectives of high power is a very large variable in this respect. Often its absorption extends into the visible region, so that it produces a marked yellow cast in the picture that is much more noticeable in the Kodachrome picture than it was directly to the eye. As mentioned before, most of the metals reflect it less than they do the longer wave lengths. In fact, only aluminum or Mach's aluminum-magnesium alloy is a neutral reflector. Anyone expecting to do metallography in color should, therefore, provide himself with a bit of first-surface aluminum mirror as a test object.[10]

At this point, it might be noted that the decrease in reflection with wave length in the visible spectrum which is common to most metals is a factor to be reckoned with. In one case, with a good reproduction of aluminum as a neutral gray, the Kodachrome picture of a shiny metal micrometer ruling persisted in looking very brown although actually the ruling, held in the hand, looked silvery. When both the aluminum and the ruling were put in the fields of a comparison microscope, the effect was startling. The metal of the ruling was as brown as its picture. Obviously, we are dealing with a similar psychological phenomenon to that which makes a piece of paper look white both in daylight and in tungsten illumination. But here we are concerned with different absorptions to the same light which is compensated for by a visual effect, since both of the two specimens mentioned again appeared a metallic gray in the hand.

At this point, also, mention should be made that all inverted stands have a first-surface mirror or prism in the image beam to reflect it to a horizontal. In those cases where this mirror is made of stellite, the color of the beam will be affected somewhat although this effect will be automatically included in the compensation discussed below.

It is best, therefore, to remove the ultraviolet component of the illumination in metallography; this will require compensation by slowing down the response of the materials to the green and red components of the illumination until a gray balance is restored. The Wratten No. 2A gelatin filter removes all of the ultraviolet radiation and some of the blue, and is very stable to light. This filter

[10] Such mirrors may be obtained on glass, such as microscope slides, from the Evaporated Films, Inc., Ithaca, N. Y.

or its spectral equivalent is recommended if the ultraviolet is to be removed.

In the separation negative method, if a sharp-cutting yellow filter is combined with the blue filter, it is only necessary to extend the exposure through this filter or to reduce the exposures through the red or green filters a proportionate amount. That is, new filter factors can be determined by the usual method (2). With a three-layer film, however, there is only one exposure so that suitable dilute color densities must be interposed that will affect only the pictures made by green and red light; in the Kodachrome process this means the middle and bottom layers.

Color Compensation Filters

It is convenient to divide into three general systems the methods of using compensation filters to correct for illumination defects caused by the filters used in removal of ultraviolet radiation from the illumination, the optics of the bench, etc. Any one of the three compensation methods might be the simplest or otherwise the most practical for a given situation. An outline of these three methods is given in Table III. The compensation filters are variable filters with regard to the nature of the illumination defect, although they should remain relatively constant when used with one equipment. The departure from a gray color balance and also the compensation for this defect can be analyzed into two factors; namely, that which affects the blue-minus blue (yellow) balance and that which affects the green-minus green (magenta) balance. This is because only two of the three color components are needed for a complete adjustment of color balance.

TABLE III.

Method	Compensation Filter (Variable as Needed)		Advisable Ultraviolet Absorbent	Original Defect
	No. 1	No. 2		
I..	Yellow absorbent for ultraviolet and blue	(*a*) Magenta or (*b*) Green	Variable for compensation (filter No. 1)	1. Excess ultraviolet and possibly blue (blue cast) 2. (*a*) Green cast or (*b*) Magenta cast
II..	Blue (or blue-green) Primary color filter	(*a*) Magenta or (*b*) Green Primary color filter	Complete such as Wratten 2A	1. Yellow cast 2. (*a*) Green cast or (*b*) Magenta cast
III..	Photometric filter A. Amber B. Bluish or use of variation of the lamp current	(*a*) Magenta or (*b*) Green	Complete such as Wratten 2A	Any color defect of small amount

It will be noticed that the Wratten 2A filter (or its equivalent) has been included in methods II and III to eliminate all ultraviolet radiation as was advised previously. Method I utilizes a filter of variable absorption in the ultraviolet and blue to balance out an excessive amount of this short-wave region that otherwise produces a blue cast in the picture.

Specifications for Variable Color Filters:

The determination of the specifications of the correct compensation filters to restore a gray balance on the color film is a much simpler procedure when the filters act as true primary colors to the film itself, for example, if a yellow filter affects only the yellow coloring matter of the finished color film, the cyan only the cyan color, etc. Only two filters of either the subtractive or the additive primaries are needed if they have the proper spectral absorption; an additive primary color should affect two of the color components equally.

In actual practice, it is usually most convenient to use a blue and magenta filter for metallography in color. The blue filter directly compensates for the yellow introduced by the excessive absorption of the ultraviolet radiation, and the magenta filter is used to neutralize a greenish cast which is usually introduced by the illumination system. The reality of this latter defect is easily observed by leading some of the original illumination of the lamp around the entire optical system with good mirrors to the plane of the ground glass and comparing it with the illumination in the camera with an aluminum mirror acting as the specimen.

A liquid filter is convenient as a variable filter, and such a filter is practicable on an optical bench. However, it is almost impossible to obtain an identical color in a dilute dye filter by successive weighings from a commercial sample. As a result of this investigation, the Kodak Research Laboratories will furnish concentrated stock solutions of a liquid blue and a liquid magenta filter. The Blue Liquid Compensating Filter is a true blue to Kodachrome film; that is, the magenta and cyan layers are affected equally, and the Magenta Liquid Compensating Filter is a true magenta to the film. From these stocks, the blue and magenta compensating filters can be made up by simple dilution by ordinary volumetric means, although care should be observed in this. Owing to the concentration of the original stock, which should last a long time, it is best to make from them a *working stock* which is 100 times more dilute (10 ml. of original stock diluted to 1000 ml. with distilled water) and from which the very dilute color filters may be made directly. In the case of the blue filter, the original stock is furnished in Pyrex bottles, and both it and the working stock of this filter should be stored in this type of glass container. The effect of both of these liquid filters on Kodachrome film is practically directly proportional to their concentration, which makes their use relatively simple.

The blue and magenta filter solutions may be mixed together in the same cell in any proportion. However, it is appreciably the more convenient practice to keep the two solutions in separate 10-mm. cells, at least until their correct composition is well established.

As was noted previously, sodium nitrite ($NaNO_2$) solution forms a filter that affects only the yellow layer of Kodachrome; although its absorption is principally in the ultraviolet region, it extends into the blue for concentrated solutions. In this case, the concentration of the salt must be varied in geometric ratio (0.5, 1, 2, 4 per cent, etc.) to produce equal increments of change in the Kodachrome reproduction. The salt is very soluble, and a solution of 500 g. per liter forms a convenient stock solution.

A few cases have been encountered where a dilute green, rather than a magenta, filter was required for filter No. 2. A solution of nickel sulfate containing some sulfuric acid is very satisfactory for this purpose, since it not only is very stable but acts as a true green to Kodachrome film, that is, the magenta component of the film is unaffected while the other two are affected equally. The following is a convenient stock solution:

Nickel sulfate (as $NiSO_4.6H_2O$.)	20 g.
Sulfuric acid, concentrated	1 ml.
Water to make	100 ml.

The bottle should be stoppered tightly, preferably with a clean rubber stopper. With this concentration of the stock, the liquid filters used on the bench will be diluted at least five times, usually considerably more depending on the conditions.

Compensation Method III:

The three compensation methods will be discussed in inverse order to their place in Table III.

An obvious and much used method of compensation is to vary the photometric filter (or, analogously, the current through the lamp) from that which would have been used if the amount of ultraviolet in the illumination had been correct and the optics of the equipment had been perfect. It is particularly useful for Type B Kodachrome film when used with a $4^1/_2$-amp. arc.

Example: When this film was used with an equipment similar to the Bausch and Lomb ILS, it was found that an excellent gray balance was obtained in the reproduction of an aluminum mirror when a Kodak Color Compensating Filter CC 13 was used, together with a 2 per cent aqueous solution of sodium nitrite in a 10-mm. cell. This is a modification of the stronger CC 15 filter which is still somewhat inadequate when this arc light is allowed to fall on the film directly or with a very simple optical system.

This method principally alters the blue-yellow balance but the green-magenta balance is affected to about one half of this extent by change of the photometric filter or change of the current through the lamp. Although this method is very useful where only slight compensation is needed, it cannot be recommended where considerable compensation is required. A filter to eliminate the ultraviolet radiation should always be included as a constant.

Compensation Method II:

Compensation Method II is the most generally useful and widely applicable of the three methods. When a filter such as the Wratten 2A is used to eliminate the ultraviolet, the Kodachrome Blue Liquid Filter directly neutralizes the excess yellow cast, that would otherwise result, with negligible effect on the magenta-cyan ratio. There is usually a greenish cast on the ground glass, especially at higher powers, and the magenta filter will neutralize this.

Since it is normally necessary to use such compensating filters in color metallography, advantage can be taken of their presence in the system to eliminate the spectrally excellent but inconvenient Davis-Gibson photometric filters[11] when daylight-type Kodachrome film is used. A gelatin filter of the necessary absorption cannot be recommended for use in the beam of the arc lamp but a glass filter, such as one of the several "Daylight-Glass" filters, is most convenient and is also satisfactory in this case, since the concentration of the magenta filter can be altered to compensate for this failure of the glass as an ideal photometric filter. An accurately determined thickness of this filter is unnecessary; in fact, it is convenient to make it thicker than would correspond to the blue absorption of the displaced Davis-Gibson photometric filter and thus reduce the concentration of the liquid blue filter that is required to neutralize the Wratten 2A filter. The blue liquid filter is then reserved for adjustment of the exact balance in achieving a neutral gray with the equipment in use.

Example: In a case where a 10-amp. d-c. carbon arc was used for metallography together with a 60-mm. *f*/1 simple aspheric lamp condenser, a plane glass reflector in the vertical illuminator, a 4-mm. apochromatic objective, and Professional Kodachrome Film for Daylight was used. Excellent color rendition was obtained with 4.7-mm. thickness of Corning Daylight Glass (Corning No. 590 filter) plus a glass cell, 10 mm. thick, containing a dilution of the blue filter *working stock* from 80 ml. to 1.0 liter and a similar cell containing a dilution of the magenta filter *working stock* from 60 ml. to 1.0 liter.

Compensation Method I:

Since reproduction with the unfiltered carbon arc lamp is always bluer than that with the same color temperature from a tungsten lamp and removing the excess ultraviolet radiation causes yellower reproduction, a variable ultraviolet filter, such as sodium nitrite solution, can be arbitrarily adjusted in concentration until a neutral balance is obtained, at least for the blue-yellow relation. A variable thickness of a Corning Noviol 0 glass filter is also useful for this purpose. In this case, the ultraviolet and the blue spectral regions can be considered a unit as they are in the photographic behavior to this film. This method is sometimes very convenient when a $4^1/_2$- or 5-amp. carbon arc is being used with Type A Kodachrome film. The method cannot be recommended in general, however. It usually leaves some ultraviolet in the illumination and if the concentration of the optimum ultraviolet filter has its cut in the region of the cyanogen peak, the color balance becomes very sensitive.

Example: A satisfactory color balance was obtained for Kodachrome Film Type A with the 4.5-amp. d-c. carbon arc as the illuminant, at medium and high magnifications, when a centimeter layer of a 4 per cent solution (40 g. per liter) of sodium nitrite ($NaNO_2$) was used. No magenta filter was needed.

Criteria for Correct Compensation:

It is impossible to quote valid examples that would be accurate for many situations since the defect in the quality of the illumination of the microscope image as compared with that of the original illuminant is at least partially dependent on the individual apparatus. However, present experience indicates that the compensation specifications (the concentrations of the two liquid compensating filters) for some of the standard optical arrangements with commercial equipment will provide the major part of any improvement over neglecting such compensation and may be sufficient for the purpose. A description of the compensation requirements for certain typical magnifications is, therefore, enclosed with the filters. If the gray balance obtained using the filters quoted in the example which seem most applicable is not sufficiently correct for the purpose, the proper balance can be obtained by using the following method.

Determination of the Correct Compensation:

The metallographic bench should be set up as usual but with a specimen that can be considered as an ideal gray on the stage. A first-surface aluminum mirror makes the ideal subject and can usually be obtained.[10] A polished steel unetched surface can be used. A series of exposure steps should be made with variable exposure; for example, each exposure can be twice as long as the preceding one. This is easily done by pushing in the draw slide of the plate holder for time exposures, or by the aid of suc-

[11] See pp. 22 and 24.

cessive snaps of the shutter, according to the length of the exposed times. One such series should be made with each proposed variation of the compensating filters. For instance, a determination of the correction to eliminate the green cast should be made by varying the concentration of the magenta (minus-green) filter alone. The correct filters will cause the steps to be gray, whereas an excess concentration of a given filter gives the gray a tinge of its hue. In metallography especially, at 100× or higher magnification, the light and medium densities on the film are the most important for judging the *color* balance. With 35-mm. or Bantam films, each frame must represent an exposure step. It is usually unnecessary to make a whole exposure series for each proposed filter. With cut sheet Kodachrome film, the black paper separators that come in the boxes of film are very suitable for making a group of masks that will allow a series of individual exposure strips to be made along a sheet of Kodachrome film. Six or seven strips may be made very satisfactorily on a 5 by 7-in. sheet of the film, each one representing a somewhat different illumination quality. This black paper will not fog the film as another paper might. The Kodachrome film must then be sent for its usual processing.

When color photography with oblique illumination is being done, a matte white surface should be used instead of the metallic mirror

Determination of Exposure

Correct exposure of the film or plate is an essential to the best quality results with any process of color photography, but this is even more strictly true of a reversal process such as Kodachrome. On the other hand, two facts make the determination of the correct exposure particularly simple yet satisfactory for Kodachrome photomicrography. First, the correct exposure for a reversal process is proportional to the brightness of the lightest area in which there is detail in the image field; second, the illumination incident on the film itself can be directly measured in the image plane, or calculated very simply from measurements made at a shorter bellows length. From the first principle, it can be seen that measurement of the average illumination of the image field is an incorrect procedure, since the contribution of the brightest area to this will vary widely with its relative size; yet it is the average illumination that is obtained by the common practice of holding a photometer near the eyepiece with the specimen in place. A fundamentally better practice is to substitute a polished but unetched specimen for the one in question for determination of the maximum brightness of the field. In actual practice in metallography by bright field with specimens of normal etching, the range of contrast is low and the area of the darker detail is about the same in all specimens so that they can be kept on the stage for the exposure determination without appreciable error.

The two facts just cited make the use of photometers for exposure determination in Kodachrome metallography particularly practical. Of course, it is inconsequential how this brightness is determined, whether by a visual photometer, by a photoelectric photometer, or in practical terms, by a photographic exposure. There are several standard types of visual photometer; they may not be practical for general photography in the field, but photomicrography is done in a laboratory. One of the simplest types is practically the old grease-spot photometer, where a small spot of diffusing material is illuminated by the photomicrographic field from below and a surrounding white reflecting material is illuminated from above by a "standard light source" which can be varied until the brightness of the two match. Photoelectric exposure meters are so convenient, however, that there have been many attempts to use them for photomicrography. With a 10-amp. arc, there is just sufficient illumination in the image plane to use a photocell, if it has a separate especially sensitive meter, but with other light sources, it must be used a short distance above the microscope to obtain a reading. Unless it can be held in the image plane, a photometer should always be held at a constant distance from the microscope, such as 10 in., or 3 in., and the reading adjusted to the variable bellows length.

For the best results, it is necessary to calibrate the photometer by actual photographic trials, however, for each different type of illumination and for each very different type of subject.

Exposure Standards

It is best to have a definite set of exposure standards, one for each type of subject or illumination, whether or not a photometer is used. Usually, this will not require many for one person. A good procedure for the Kodachrome process is as follows:

Set up a test specimen and with a piece of Kodachrome film on the holder, make a series of time exposure steps with the draw slide, pushing it for 1 in. after successive intervals of 1, 1, 2, 4, 8, etc., sec. (or proportional thereto). With an arc, this may be $^1/_{100}$, $^1/_{100}$, $^1/_{50}$, $^1/_{50} + ^1/_{25}$, $^1/_{10}$, $^1/_{10} + ^1/_5$, $^1/_2$, 1, etc., seconds. The result is a series of exposures, each twice the last or equal to the next exposure time of the shutter. This film should be sent for processing. A duplicate series of exposures should be made immediately, using Kodak Super Speed Direct Positive Paper. The processing is very simple and rapid. When the film is returned, the two should be kept together as a standard, since it is then always possible to estimate what some new test would look like on Kodachrome film upon comparison of its black-and-white (Direct Positive) test with this standard.

Super Speed Direct Positive Paper is approximately twice as fast as Kodachrome Professional Film Daylight Type when used with the 10-amp. arc screened to daylight and minus the ultraviolet. It has about the same speed as Type B Kodachrome film to illumination at 3200 K. It is green- but not red-sensitive so that bright reds are reproduced by dark tones, a fact which must be remembered.

Application of Color Photography to Metallography

A series of Kodachrome pictures was made to illustrate the subject specifically.[12]

[12] At least one color picture was made to illustrate each important field of application, most of which were shown before the Society at Atlantic City, June 28, 1939. Only the few examples that can be reproduced here will be described.

When the author was asked to undertake the preparation of this paper, he was promised that specimens would be supplied, and in accordance with this arrangement, all of them were obtained through the courtesy of others.

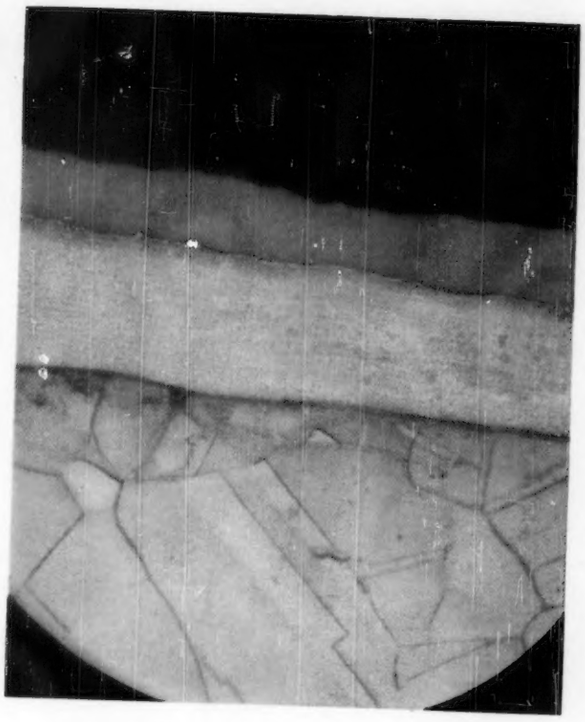

Fig. 5.—High Speed Copper on Brass (×500).

Fig. 6.—Alclad 17S-T (×100).

Fig. 7.—Nichrome Nickel Alloy from Oxidized Ribbon Element of Heater (×90).

Fig. 8.—Manganese Bronze (polarized light) (×100).

First among the applications to metallography may be considered the examination of differently colored metals themselves, mostly in the form of platings. Actually, this is one of the most exacting of all of the applications because it calls for the reproduction of the correct metallic sheen. Here our criterion was the reproduction of a first-surface aluminum mirror as gray. An exposure step wedge photographed with the same illumination and through the same optical system but from a first-surface aluminum mirror was put on one end of the 5 by 7-in. sheet of Kodachrome film which was used later for the metallographic example. Since the aluminum was reproduced as neutral gray, the sheen of the metals must be correctly reproduced in the original Kodachrome of Fig. 5. This specimen[13] was labeled "High-Speed Copper on Brass." The outer coating is nickel.

The coloration produced by etching agents forms a variation of this classification; since the illumination is the usual specular or bright-field type, there will probably be some area that has the original metallic luster. Figure 6 is a Kodachrome transparency of a sample of Alclad 17S-T (14-gage sheets).[14] The surface of this sample was not touched after its arrival.

At this point, we can consider Professor Gaudin's method of "selective iridescent filming." (*12*) By his technique, he produces a thin tarnish film over his specimen, usually by oxidation, of such thickness as to produce interference colors. Since the different constituents tarnish at different rates, the thickness of the film over them will vary in thickness; in fact, the refractive indices may also vary, producing interference patterns that resemble the pattern of the constituents. Even different crystals of a single material may give different film thicknesses and hence be of different colors. Gaudin claims to be able to do this in a quantitative and reproducible manner. While he is interested primarily in mineralogy, it seemed to the author that the method could be developed so as to be applicable to metallography.[15]

Closely related to mineralogy or petrography is the very common examination of inclusions in metals. The simplest class consists of those cases where the inclusions themselves are colored materials. Such a case is that of the yellow zirconium nitride crystals in tool steel. Another example of this general class is the constituents of a casting metal such as an aluminum-copper-silicon-iron alloy.

Many colored constituents are best viewed by nonspecular illumination which is produced by the metallographic dark-field illuminator or such a device as the Leitz Ultrapak. This type was illustrated by a specimen of a copper bus bar oxidized in service, taken with vertical illumination and then with dark-field illumination. In the latter case, the cuprous oxide showed as a brilliant scarlet. This is also illustrated in Fig. 7 which represents a nichrome-nickel alloy from the ribbon element of a heater.[16] Here the color resides in the green chromium oxide produced by intergranular oxidation during service. It was photographed with the illumination for a Leitz Ultrapak, but the color was intensified by using polarized light obtained with crossed Pola-screens.

Finally, we come to those cases where the colors are the product of the polarized light on the specimen. Here the situation is closely related to that in petrography and is the one usually considered so that little need be said about it here. The colors are likely to be the most intense with little or no areas of any color easily recognized for correctness so in that sense this case is less exacting than those previously considered (except for the consideration mentioned previously[17]). The example shown in Fig. 8 is a manganese bronze from the Frankford Arsenal and was taken with polarized light on the new Research Metallographic Stand of the Bausch and Lomb Optical Company through the courtesy of that company.

Acknowledgment:

The author wishes to thank collectively those who sent samples for use as examples.

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[13] Sent to us by Mr. J. W. Goodrick of the R and H Chemicals Dept. of E. I. duPont de Nemours & Co. Dr. Ruby of our department finished the sample and etched it with ammonium hydroxide-hydrogen peroxide mixture.

[14] Sent in by Dr. F. Keller of the Aluminum Research Laboratories.

[15] Some Kodachrome slides of 35-mm. size, one of a zinc alloy, were shown that had been lent by Professor Gaudin. Although they are not reproduced here, colored reproductions of some of his Kodachrome examples are contained in the first paper of reference 12.

[16] Obtained through the courtesy of the Bausch and Lomb Optical Co.

[17] See p. 21.

Emergency Actions on Standards

ON THE RECOMMENDATION of certain standing committees, the Society, through its Committee E-10 on Standards, has recently approved a number of actions involving Emergency Alternate Provisions and a complete Emergency Alternate Specification. These items are listed in the accompanying box. Each will be issued in the usual "pink slip" form and copies will be distributed to the members in the near future. Meanwhile, those members who wish to have the material as soon as possible may send requests to A.S.T.M. Headquarters.

Although in a number of fields the Society's standing committees are recommending withdrawal of "pink slips" or Emergency Specifications or the transfer of these emergency matters into the status of regular standards because their need to expedite procurement or conserve critical or strategic materials is not as pressing as formerly, there are still cases where in the interests of the war effort additional emergency actions must be approved.

Steel Castings:

The Emergency Alternate Provisions which became effective on April 26 involving three widely used steel casting specifications, all three for high-temperature service—A 95, A 157, and A 216—provide emergency hydrostatic test pressure requirements which tie in with war standard pressure temperature ratings B16e5 and clarify the time of testing, namely, to be done after rough machining. This is the only problem in Specifications A 157, whereas in the other two items new grades are being added. In the more general specification A 95, a new grade with tensile strength of 65,000 psi.; yield point, 35,000 psi.; elongation in 2 in., 20 per cent; and reduction of area, 30 per cent, is being set up. A grade with similar physical properties, but with modified chemistry is being established in A 216 which covers carbon-steel material suitable for fusion welding for service up to 850 F. In this latter specification, two existing emergency grades for pressure containing turbine castings are continued, the new Grade EWCB being considered suitable for valves, flanges, and fittings.

Testing and Tolerances for Knit Goods:

This Emergency Alternate Provision, providing an alternate type condenser in the extraction apparatus which is used in determining the amount of grease, is based on the effort to conserve block tin tubing. The change involves details of the new type of condenser which has been incorporated in other A.S.T.M. "pink slips."

Asphalt Shingles:

In order to provide an acceptable standard specification for asphalt shingles surfaced with coarse mineral granules, and to coordinate requirements with those established by the Federal Specifications Executive Committee and through Government Limitation Orders, Committee D-8 on Bituminous Waterproofing and Roofing Materials has developed the new complete Emergency Alternate Specifications for Asphalt Shingles Surfaced with Coarse Mineral Granules (EA – D 225). This emergency specification covers manufacture, character of felt, physical properties, sampling and testing, etc. The scope indicates that the specifications cover asphalt roofing in shingle form, composed of roofing felt saturated and coated on both sides with asphalt and surfaced on the weather side with granulated slate or equivalent mineral material (of solid or mixed colors as may be agreed upon by the purchaser and the seller), and on the reverse side with a suitable material to prevent sticking in the package. The scope further details the use of the various shingles, the amount of exposure to the weather, and the type, that is, whether the regular, heavy, or heavy butt.

Recent Actions by Committee E-10 on Standards

EMERGENCY ALTERNATE PROVISIONS

Standard Specifications for:

EA – A 95 Carbon-Steel Castings for Valves, Flanges, and Fittings for High-Temperature Service (A 95 – 41).

EA – A 157 Alloy-Steel Castings for Valves, Flanges, and Fittings for Service at Temperatures from 750 to 1100 F. (A 157 – 42).

Standard Methods of:

EA – D 231 Testing and Tolerances for Knit Goods (D 231 – 39).

Tentative Specifications for:

EA – A 216 Carbon-Steel Castings Suitable for Fusion Welding for Service at Temperatures up to 850 F. (A 216 – 42 T).

EMERGENCY ALTERNATE SPECIFICATIONS

Specifications for:

EA – D 225 Asphalt Shingles Surfaced with Coarse Mineral Granules (EA – D 225).

Textile Chemists and Colorists Year Book

RECENTLY AVAILABLE is the current Year Book of the American Association of Textile Chemists and Colorists. This 700-page volume provides, in addition to details on the organization and committee reports which section aggregates some 140 pages, standard A.A.T.C.C. Test methods. A major portion of the volume, as customary, includes detailed tabulations of American dyes and textile chemical specialties. There is also included a complete list of the members of the Association and a subject index.

Copies of the book can be obtained from the Howes Publishing Co., Inc., 440 Fourth Ave., New York, at $3.50 per copy.

Guide to Weldability of Steels

THIS 96-PAGE publication of the American Welding Society covers a proposed system of determining the effect of welding procedure upon the ductility of the heated zone adjacent to the weld in plain carbon and alloy steels and discusses how to retain ductility in constructional steel. The work on which the guide is based was carried out originally under the sponsorship of the Welding Research Council until in 1942 the project was taken over by the War Metallurgy Committee. Following general instructions, there are given step-by-step procedures and practical examples, then the experimental basis of the system is described and finally the effects of secondary variables. Copies can be obtained from the American Welding Society, 33 West 39th St., New York, at $1.00.

The Salt Spray Test

by V. M. Darsey[1]

THE INCREASE in use of the salt spray test[2] as a requirement of many specifications for protective finishes makes it essential that the test results be reproducible which suggests that further consideration be given as to how certain of these factors in salt spray testing should be controlled. At the time of the A.S.T.M. Spring Meeting the important factors in standardizing the salt spray test were discussed, and a report was made on the work conducted by the Military Planning Division of the Office of the Quartermaster General in cooperation with the Metallurgical Section of the National Bureau of Standards. This work resulted in the issuance of Quartermaster Corps Tentative Specification OQMG No. 156, dated December 31, 1943. In view of the fact that agreement on several points in this specification could not be obtained, a meeting was scheduled at the National Bureau of Standards, Washington, D. C., March 15, 1944. Present at this meeting were representative members of the Army, Navy, War Production Board, National Bureau of Standards, American Society for Testing Materials, National Paint, Varnish, and Lacquer Association, Federation of Paint and Varnish Production Clubs, and members of the paint industry. General agreement was obtained from this group that *one* standard salt spray test should be developed and used by all instead of the variety of salt spray tests required in numerous existing specifications.

Salt Spray Test

The salt spray test is a method of producing accelerated corrosion of articles placed in a finely divided dense wet fog produced and maintained by atomizing a 20 per cent solution of sodium chloride with air inside a cabinet at 92 to 97 F. It is believed the lack of adequate methods for measuring and maintaining a uniform concentration of salt fog inside the cabinet during operation is primarily responsible for most irregular salt spray test results. It has long been recognized that the amount and type of salt fog present in the cabinet influences the rate of corrosion of exposed specimens, and various methods have been proposed for measuring it such as:

1. The fog shall be of such density that the outlines of a 100-w. lamp shall not be distinguishable at a distance of 5 ft.[3]

2. When a fog trap of known size is hung in the fog for a given time, there shall be a minimum and maximum gain in weight (A.S.T.M. Method B-117).[2]

These two methods for calibrating the fog inside a salt spray cabinet do not distinguish between so-called wet or dry fog which are recognized to have different corrosion rates, nor do they distinguish between salt fog and fog resulting from the atomization of water free of salt. At most, such fog observations serve only to affirm the fact that a solution is being atomized inside the cabinet.

In the interest of promoting more uniform test results, the author has conducted considerable research work on a quantitative method of calibrating the salt fog inside the cabinet, and presents herewith the results for consideration in the revision of the test.

It is recognized from observations that a wet salt fog is more corrosive than a dry salt fog, and it was reasoned that the humidity inside the cabinet influenced the wetting of specimens and their resultant corrosion. Before proceeding to determine the humidity in a salt spray cabinet, the humidity resulting from various concentrations of sodium chloride at equilibrium were computed from published vapor pressure data[4] and included in Table I. Since the vapor pressure of sodium chloride solution at 95 F. (35 C.) was not given, the data at 30 C. and 40 C. were selected and the corresponding humidity calculated and included in columns four and five of the table.

TABLE I.

NaCl, per cent	Vapor Pressure, mm. of Hg		Relative Humidity, per cent	
	30 C.	40 C.	30 C.	40 C.
0	31.83	55.34	100	100
2.5	31.4	54.5	99	98
5.0	30.9	53.6	97	97
7.5	30.4	52.7	96	95
10.0	29.8	51.7	94	94
12.5	29.2	50.7	92	92
15.0	28.5	49.7	90	90
17.5	27.7	48.1	87	87
20.0	26.8	46.6	84	84
22.5	25.8	44.9	81	81
25.0	24.7	43.0	78	78
26.6 Saturated	23.9	41.6	75	75

Atomizing a 20 Per Cent Sodium Chloride Solution

Reference to Table I reveals that at equilibrium the atomizing of a 20 per cent salt solution results in a relative humidity of 84 per cent inside a test cabinet. It further shows that at a given humidity, it can be established whether the salt particles in the fog will "give-up" moisture to the air, or "take-on" moisture from the air inside the cabinet. For instance, if it is determined that the relative humidity inside a cabinet is less than 84 per cent, the salt particles of the fog will "give-up" moisture to the air and thus tend to become a dry salt fog. Likewise, a relative humidity greater than 84 per cent indicates the salt particles of the fog tend to "take-on" moisture from the air inside the cabinet. Any gain or loss in moisture of atomized salt fog particles can be ascertained by collecting some of the solution resulting from the fog and determining its sodium chloride concentration.

A sodium chloride content in collected fog solution exceeding 20 per cent indicates the system was not operating at equilibrium and some loss of moisture from the

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

[1] Technical Director, Parker Rust-Proof Co., Detroit, Mich.

[2] The salt spray test is described in A.S.T.M. Tentative Method of Salt Spray Testing of Non-Ferrous Metals (B 117 – 41 T), 1942 Book of A.S.T.M. Standards, Part I, p. 1469; and in the Emergency Method for Conducting Salt Spray Tests on Organic Protective Coatings (ES – 3), 1942 Book of A.S.T.M. Standards, Part II, p. 1020.

[3] C. E. Heussner, American Electroplaters Society, June 1942, p. 75.

[4] International Critical Tables, Vol. III, p. 369 and 370.

salt fog particles to the air inside the cabinet has occurred. This condition generally results from atomizing a salt solution with air containing less than 84 per cent relative humidity or the use of a salt solution more concentrated than 20 per cent. Similarly, a salt content in the collected fog solution less than 20 per cent indicates that water has been added to the atomized salt fog particles. This may occur by:

1. Evaporation of water from the heated salt solution in the reservoir located inside the cabinet to maintain proper chamber temperature.
2. Introduction of excess water with the air employed for atomizing the salt solution.
3. Evaporation of moisture from fog solution coming in contact with any section of the cabinet which is heated to a temperature substantially above 95 F. (35 C.) for the purpose of maintaining chamber temperature.

Salt Spray Operating Conditions

For this work, the normal conditions of salt spray operation were as follows:

1. Cabinet size, 7 ft. 3 in. by 7 ft. 2 in. by 8 ft. 4 in. high.
2. Sodium chloride solution 20 per cent.
3. Air pressure 10 psi. at nozzle.
   (*a*) Passed through water to remove oil and dirt.
   (*b*) Heated to 120 F. and humidified by passing through water at 125 to 130 F. in the saturator.
4. Auxiliary heat to maintain chamber temperature provided by four strip heaters on the side wall of cabinet.
5. Atomization by four nozzles located at the top in each corner of chamber and directed toward side walls of cabinet.
6. All atomized salt solution allowed to enter drain without respraying.

Measurement of Humidity in Salt Spray Cabinet

Considerable difficulty was experienced due to the thickness of the walls of the cabinet before a satisfactory procedure was evolved for measuring during operation the humidity inside the salt spray. The final procedure employed and one which produced reproducible results consisted of the following: Two thermometers (wet and dry bulb) and an exhaust tube contained in a stopper were inserted in a liter suction flask. On the entrance tube of the flask was placed a fritted glass filter to remove all salt fog particles from the air drawn through the flask and over the thermometers. A rubber tube from the exhaust of the flask was extended through a hole in the door of the cabinet and connected to a water aspirator. It was found that this apparatus placed inside the salt spray cabinet required 30 to 45 min. for the wet bulb to reach equilibrium after starting the aspirator. It is essential that the door of the cabinet be opened and closed quickly when the person making the temperature readings enters or leaves the salt spray cabinet. The final temperature recorded was that of two or more readings of the same temperature on the separate thermometers. From the difference in wet and dry bulb temperature, the relative humidity was ascertained.

For measuring during operation the humidity inside a small salt spray cabinet (28.2 cu. ft., size $37\frac{1}{2}$ by $38\frac{1}{4}$ by 34 in., 1-in. insulation on walls), a glass tube 2.7 cm. inside diameter by 20 cm. long was inserted through a hole in the side wall of the cabinet. A rubber stopper containing the wet and dry bulb thermometers and the exhaust tube was placed in the exit end of the glass tube so the thermometers could be read outside the cabinet. On the entrance end of this tube inside the cabinet was installed a fritted glass filter to remove the salt particles from the air drawn through it and over the thermometers. The small exit tube in the assembly was connected to an aspirator for exhausting air over the thermometers. The thermometers inside the tube assembly extended into the cabinet about 3 or 4 in. and no condensation occurred on the dry bulb during operation. This method which produced satisfactory and reproducible results is believed applicable for measuring humidity in any salt spray cabinet containing a suitable opening for the tube assembly and whose walls do not exceed 2 in. in thickness.

At the time actual humidity determinations were made by wet and dry bulb readings, fog solution was collected and salt concentration determined from which the corresponding humidity was obtained from data in Table I.

Relationship Between Humidity and Salt Fog Concentration

To study the relationship between humidity inside a large salt spray cabinet (433 cu. ft.) and the concentration of the salt fog particles, measurements of humidity and fog solution concentration were made from atomizing different concentrations of sodium chloride and ordinary water.

In Table II is a record of atomizing water, 10 per cent sodium chloride and 20 per cent sodium chloride solution, and the resultant humidity as determined by actual

TABLE II.—LOG OF SALT SPRAY TEST (EXPERIMENTAL DATA).

Date, 1944	Salt in Reservoir Solution, per cent	Temperature, deg. Fahr.		Relative Humidity, per cent	Appearance of Fog	Collected, ml. per hr.	Salt Solution Collected, per cent	Relative Humidity by Solution Collected, per cent
		Dry Bulb	Wet Bulb					
3-12	None[a]	96	96	100	Dense	3.0	1.5	99
3-13	20.0	94.0	88	79	Dense	...	24.0	79
	20.0	95.0	88	75	Dense	None	...	..
3-21	20.0	96.0	88	72[b]	Dense	None	...	..
	10.1	93.75	90.50	91	Dense	3.2	11.8	93
	10.3	92.5	90	91	Dense	2.4	12.4	92
3-22	10.2	92	90	92	Dense	2.9	11.3	93
3-23	10.1	93.5	91.5	92	Dense	3.2	10.8	94
3-24	20.0	93	88	82	Dense	...	19.8	85
3-25	20.0	92.5	87.75	83	Dense	...	19.5	85
3-27	20.0	92.75	89.0	86	Dense	...	20.4	84
3-28	20.0	93.5	88.5	82	Dense	...	...	..
3-29	20.0	93.5	88.75	83	Dense	3.0	19.9	84
3-30	20.0	91.0	86.0	82	Dense	2.6	20.8	83
3-31	20.0	93.5	89.5	82	Dense	...	20.8	83

[a] Water without salt.
[b] Purposely created.

TABLE III.—DAILY LOG OF SALT SPRAY TEST.

Date, 1944	Salt in Reservoir Solution, per cent	pH Salt Solution	Average Solution Sprayed, gal. per 24 hr.	Temperature, deg. Fahr.		Relative Humidity, per cent	Appearance of Fog	Collection Time, hr.	Solution Collected, ml. per hr., avg.	Salt in Solution Collected, per cent	Relative Humidity by Solution Collected, per cent
				Dry Bulb	Wet Bulb						
4-1.....	20.0	6.7	16.8	90.0	85.5	83	Dense	...	...	...	...
4-3.....	20.0	6.7	16.8	94.0	89.0	82	Dense	24	2.8	18.5	86
4-4.....	20.0	6.7	16.8	94.0	90.0	85	Dense	24	3.2	19.8	85
4-5.....	20.0	6.7	16.8	95.0	90.0	82	Dense	24	2.1	20.0	84
4-6.....	20.0	6.7	16.8	94.0	89.5	83	Dense	24	2.5	19.9	84
4-7.....	20.0	6.7	14.5	92.5	88.5	85	Dense	24	2.6	19.9	84
4-8.....	20.0	6.7	14.5	94.5	90.0	84	Dense	24	2.9	19.8	85
4-10.....	20.0	6.7	14.5	...	...	...	Dense	48	3.0	19.8	85
4-11.....	20.0	6.7	14.5	93.5	89.5	85	Dense	24	2.8	19.9	84
4-12.....	20.0	7.1	14.5	93.0	89.0	85	Dense	24	2.8	19.8	85
4-13.....	20.0	7.1	14.5	94.5	90.5	85	Dense	24	3.2	19.8	85
4-14.....	20.0	7.1	14.5	93.5	89.5	85	Dense	24	3.1	19.8	85
4-15.....	20.0	7.1	14.5	94.0	90.0	85	Dense	24	3.2	19.9	84

measurement and also from concentration of fog solution collected.

No difference in the appearance of the fog inside the cabinet was observed during any of the experiments whether water, 10 per cent salt, or 20 per cent salt solution was atomized. A difference in humidity resulted from atomizing the separate solutions which agreed quite well with the theoretical for such solutions at equilibrium as listed in Table I. Attention is called to the close relationship between the concentration of sodium chloride in the solution of fog collected and the original solution before atomizing, except in one instance where a condition of low humidity was purposely produced. To create this dry salt fog (low humidity) in the salt spray cabinet, all operating conditions remained the same except that the air did not pass through water in the saturator tower and was used at approximately 75 F. instead of 120 F. Upon spraying for several hours under this condition, the humidity in the cabinet became less and less by actual measurement until a dry fog was obtained at which time it was impossible to collect any fog solution. At the time a dry salt fog was thus obtained, difficulty was experienced from nozzles plugging and failing to atomize the salt solution.

It was established from this experimental work that the relative humidity in a salt spray cabinet is directly related to the sodium chloride content of the fog. Good agreement of humidity in a cabinet was obtained from salt concentration measurement of fog solution collected and humidity measurement by wet and dry bulb thermometers. Since the method of collecting a solution of fog and determining its salt concentration is more convenient than humidity measurement, the following procedure is suggested for calibrating the salt fog inside a salt spray cabinet:

Atomization

It is suggested that the apparatus produce under normal operating conditions a finely divided wet dense fog, such that when a fog collector made from a 10-cm. glass funnel inserted through a stopper in a 100-ml. graduated cylinder is placed in a vertical position in the cabinet in the location of the test specimens, 2.0 ± 1 ml. of solution having a sodium chloride concentration between 18 and 23 per cent shall be collected in 1 hr. based upon an average run of not less than 16 hr.

Note.—When using nozzles made of glass, hard rubber, plastic, metal or any nonreactive material to the salt solution, suitable atomization has been obtained in laboratory boxes having a volume of less than 12 cu. ft., with the following conditions:

1. Nozzle pressure of from 12 to 18 lb.
2. Orifices of from 0.02 to 0.03 in. in diameter.
3. Atomization of approximately 3 qt. of salt solution per 10 cu. ft. of box volume per 24 hr.

Atomization Calibration Test

While a test is in progress at least two fog collectors should be operated during the testing period. Results should be recorded based on every 24-hr. period of test or fraction thereof. The fog collectors should be so placed within the exposure zone that at least one is at a minimum distance from any nozzle and the other a maximum distance from all nozzles.

Note 1.—It is essential that the funnel of the fog collector be in a vertical position and so located in the cabinet that drops of solution from the test specimens or other source will not fall into it.

Note 2.—For measuring the concentration of sodium chloride in the fog solution contained in a 100-ml. cylinder, a hydrometer 10 cm. long with a range of 1.120 to 1.190 with subdivisions of 0.001 has proved convenient.

Daily Log of Salt Spray Test

In Table III is a daily operating record of a large salt spray cabinet and the information contained therein affords a fairly complete record of the important factors during any test period. The information as to humidity is included to show further that the concentration of salt in the fog solution collected establishes whether the apparatus has operated at or near equilibrium conditions. The four columns, namely, dry and wet bulb temperature, relative humidity, and relative humidity by solution collected would be omitted in any normal daily log of salt spray test.

The average gallons of solution atomized (in Table III) per day were obtained from the total volume used each week.

The fog solution collector in addition to providing a quantitative method of measuring the amount and concentration of fog in a salt spray cabinet has proved a reliable indicator of operating conditions. When the average volume in milliliters of fog solution collected each 24 hr. has been established from daily operating experience, the collection of any volume substantially different from this normal average indicates an operating difficulty. When more than one nozzle is employed in a cabinet, the plugging of a nozzle is reflected by the collection of a smaller volume of fog solution than normal.

It is believed that little, if any, exception would be taken to the statement that "the corrosiveness of a salt fog of a given particle size is dependent upon whether it is wet or dry and that the concentration of salt in a solution of fog collected is a measurement of the wetness or dryness of the fog as it existed in the salt spray cabinet." The point on which it is desirable to have more experimental data is the permissible limits of fog solution necessary to collect each hour with a given size collection receptacle. The volume of 2.0 ± 1 ml. for a 10-cm. funnel

collector has been suggested based upon collection data obtained from large, medium, and small salt spray cabinets. With a single exception all cabinets tested come within this fog solution collection requirement. In the case of this exception there was collected approximately 0.75 ml. of fog solution per hour which contained the same amount of sodium chloride as the original solution before atomizing. It was reported that the appearance of the fog in the cabinet was dense and the reason for the small amount of fog solution collected was attributed to the finely divided particle size of the salt fog. Coarse salt fog particles will of course fall more rapidly than finer particles; however, any measurement of salt fog particle size is complicated and believed unnecessary for standardizing the salt spray test. Regardless of the size of salt fog particles in a cabinet they will eventually fall and be collected by this proposed method, and the minimum amount of such fog solution collected per hour should be such that it will insure adequate wetting of the test specimens. Whether there is any appreciable difference in the corrosion rate of a salt fog inside a cabinet which produces about 3.0 ml., 1.5 ml., and 0.5 ml., respectively, per hour of fog solution with a 10-cm. funnel collector is the object of present experimental work, the results of which should be available shortly. It is recognized that the concentration of salt in the fog solution collected is of greater significance than the amount of solution collected, providing the amount is sufficient to insure adequate wetting of test specimens. When specimens are wet and maintained wet during testing, additional fog solution is not necessary nor believed to influence the rate of corrosion.

Other Important Factors in the Salt Spray Test

There are certain other important factors in salt spray testing that should be given consideration:

Salt.—The salt shall be sodium chloride containing on the dry basis not more than 0.1 per cent sodium iodide or more than 0.2 per cent of total impurities.

Salt Solution.—The salt solution should be prepared by dissolving 20 ±2 parts by weight of salt in 80 parts by weight of distilled water or other waters containing no more than 200 ppm. of total solids. The salt solution should have a specific gravity of from 1.126 to 1.157 when measured at a temperature between 92 and 97 F. and should be so maintained during the test. Before being placed in the salt solution reservoir, the solution should be filtered through several thicknesses of tightly woven cloth or other suitable filtering material.

Salt Solution Reservoir.—The salt solution reservoir should be thoroughly cleaned every week and the concentration of the salt solution determined each day of operation by measurement with a suitable hydrometer.

pH of the Salt Solution.—The pH of the salt solution should be maintained from 6.5 to 7.2. The pH measurement, made electrometrically, can be adjusted by additions of c. p. hydrochloric acid and/or c. p. sodium hydroxide.

Salt Fog Chamber Temperature.—The temperature of the interior of the salt fog chamber should be maintained at 92 to 97 F. Under no conditions should the use of a heater in the salt solution be permissible to obtain the necessary temperature inside the cabinet. The use of a heater to preheat the air by passing the air through a water column prior to atomization of the salt solution is permissible. Housing the salt spray cabinet in a room maintained at 92 to 97 F. is a satisfactory method of temperature control. A water jacket apparatus with facilities for temperature control of the water will also control the cabinet temperature satisfactorily.

Air Cleaner and Saturator.—The compressed air supplied to the atomizers should be freed of all impurities such as oil or dirt, and have a relative humidity not less than 85 per cent.

Baffling the Salt Fog.—The fog should be baffled prior to coming in contact with the test specimens in order that the salt fog shall not directly impinge upon the test specimens after atomization. The fog should circulate freely around all the specimens as uniformly as possible. Salt solution which has come in contact with test specimens should not be returned to the salt solution reservoir for respraying.

Acknowledgment:

The author is indebted to several of his coworkers for their generous assistance in conducting this work and to the Parker Rust-Proof Co. for permission to publish it.

WPB Directives Revised

Amendments to three important WPB directives became effective on March 30 involving the use of structural steel, reinforced concrete and structural lumber for buildings. Number 9 for reinforced concrete buildings was amended to increase the amount of reinforcing steel that may be utilized, to exempt from their provisions small projects using less than five tons of steel, and to eliminate some of the paper work requirements for the construction industry. The amendment removes the former preferences given to the use of nonreinforced concrete or masonry in the construction of footings, walls, piers, retaining walls, and buttresses. It also removes the necessity for the use of extra deep members formerly required to save reinforcing steel. The extreme fiber stress in compression in flexural members has been increased from 0.35 to 0.45 of the ultimate strength of the concrete.

Directive 8, National Emergency Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, is amended to exempt construction projects requiring five tons or less of structural steel. Likewise, the necessity for the submission of a design certificate has been removed. In Directive 29, the amendment makes unnecessary the submission of a certificate of compliance with the National Emergency Specifications for the Design, Fabrication and Erection of Stress Grade Lumber and Its Fastenings for Buildings.

Book on Welded Steel Structures

The American Welding Society, 29 West 39th St., New York, N. Y., has just issued in book form a very extensive technical paper published in its September. 1943, *Welding Journal* covering "Practical Design of Welded Steel Structures" by H. Malcolm Priest, but the book also includes other material by the author covering engineering essentials for welders. The October ASTM Bulletin cited this paper as an outstanding one, concisely written, splendidly illustrated, and of interest not only from the general standpoint, but also to the welding specialist. Copies of the book of 153 pages, page size 5 1/8 by 7 3/4 in., can be obtained at $1.00 each.

Annotated Bibliography of Aluminum Cleaning

Prepared by Jay C. Harris[1] and Robert B. Mears[2]

Continued from March, 1943 ASTM Bulletin

Since the information developed through preparation of the Bibliography for 1943 proved of value to Section G on Metal Cleaners of Subcommittee II on Specifications of the A.S.T.M. Committee D-12 on Soaps and Other Detergents in the preliminary development of corrosion and metal cleaning tests, it was decided that it should be continued. This edition is numbered numerically continuing from the last reference of the 1943 Bibliography. References 1 to 63 appear in ASTM BULLETIN No. 120, January, 1943, p. 33, and references 64 to 127 in ASTM BULLETIN No. 121, March, 1943, p. 33. The 1943 Bibliography was also published in the A.S.T.M. Standards on Soaps and Other Detergents, p. 107. (Issued as separate publication.)

Pertinent references prior to 1943 have been included in the present edition. Also included this year are abstracts of Federal Specifications relating to metal cleaning. These are reference numbers 192 to 209 inclusive.

The information which has been abstracted comprises various types of commercial cleaning methods, means for inhibiting corrosion, and descriptions of published laboratory techniques for the evaluation of metal cleaning detergents.

(128) Clete L. Boyle, "Cleaning Agent for Metals That Are to be Painted," Canadian Patent No. 356,078; *Chemical Abstracts*, Vol. 30, 2669 (1936).

Mixture of an acid, such as phosphoric, in oil solvent, such as monobutyl ether or ethylene glycol. A compatible wetting agent such as the soluble salt of an alkylated naphthalene sulfonic acid may be used in acid solution.

(129) Charles B. Durgin (to Swann Research, Inc.), U. S. Patent No. 2,037,566 (1936).

A cleaner for tin, zinc, and aluminum comprising the following:

Material	Parts
Trisodium phosphate	63
Sodium perborate	10
Sodium silicate (ratio of $Na_2O:SiO_2$ of 1:2 or 1:1.32)	25
Magnesium sulfate	2

(130) W. W. Davidson, "Solvent Degreasing," *Transactions*, Electrochemical Soc., Vol. 72, pp. 413–427 (1937).

The solvent degreasing process for the removal of oil and grease from articles prior to being electroplated or otherwise "finished" is described in some detail. Fundamental principles of equipment design and the characteristics of the stabilized, noninflammable solvents are discussed.

(131) Carroll L. Griffith and Lloyd A. Hall (to The Griffith Laboratories, Inc.), "Inhibited Detergent Composition," U. S. Patent No. 2,155,045 application, July 20, 1938.

A corrosion-inhibiting alkaline composition for cleaning zinc, iron, and tin ware in an aqueous solution thereof at from cold to boiling temperatures consisting by weight essentially of about 85 per cent of water-soluble inorganic alkaline detergent, about 5 to 7.2 per cent of a solid hypochlorite salt of a metal from the group consisting of alkali metals and alkali earth metals, and about 9 to 10 per cent of zinc compound from the group consisting of water-soluble zinc salts, zinc oxide, zinc hydroxide, and zinc carbonate.

(132) Carroll L. Griffith and Lloyd A. Hall (to The Griffith Laboratories, Inc.), "Inhibited Detergent Composition," U. S. Patent No. 2,155,046 application, February 28, 1938.

A corrosion-inhibiting alkaline composition for cleaning zinc, iron, and tin ware in a solution thereof at from cold to boiling temperatures consisting essentially of about 85 per cent of water-soluble inorganic alkaline detergent, about 5 to 6 per cent of a solid hypochlorite salt of a metal from the group consisting of alkali metals and alkali earth metals, and about 9 to 10 per cent of water-soluble zinc salt.

(133) Robert H. Brown and Robert B. Mears (to Aluminum Company of America), "Composition for Cleaning Aluminum," U. S. Patent No. 2,316,219 application, April 22, 1939.

A dry water-soluble aluminum-surface cleanser for use in aqueous solution, said cleanser being characterized by an acidic cleansing reaction in said solution and consisting substantially of an alkali metal fluoride and metaphosphoric acid, the latter being the major component and the principal active cleansing agent.

(134) Robert H. Brown and Robert B. Mears (to Aluminum Company of America), "Composition for Cleaning Aluminum," U. S. Patent No. 2,316,220 application, April 22, 1939.

This comprises a mixture of alkali metal fluoride and ammonium dihydrogen phosphate.

(135) W. L. Davies, "Dairy Detergents," *Dairy Industry*, Vol. 4, No. 1, pp. 3–6 (1939).

The analyses of 11 dairy detergents are given. Four of these contain colloidal materials, all contain NaOH and Na_2CO_3 and many contain Na_2SO_3 or Na_3PO_4 or both. Soda ash is the constituent contained in greatest percentage in most of the detergents. Analytical procedures are given for determining these various alkaline materials in the presence of the others.

(136) The Griffith Laboratories, Ltd., "Metal-Cleaning Detergent," Canadian Patent No. 388,542; *Soap*, Vol. 16, p. 65 (1940).

An alkaline composition for inhibiting corrosion and cleaning zinc, iron, and tin ware at temperatures varying from cold to boiling consists of about 85 per cent of water-soluble inorganic alkaline detergent such as soda ash and trisodium phosphate, 5 to 6 per cent of a solid hypochlorite, and 9 to 10 per cent of a water-soluble zinc salt.

(137) E. E. Halls, "Efficient Trichloroethylene Degreasing," *Metal Treatment*, Vol. 6, pp. 131–133 (1940); *Chemical Abstracts*, Vol. 35, 6903 (1941).

Attention is given to the following points for efficient operation: low running costs, good cleaning, and high production rates, solvent degreasing can be the cleanest, most rapid, efficient, and safest of cleaning operations. Choose the best stabilized solvent. In design of plant consider mode of heating, recovery of solvent, escape of vapor, and adequacy of cooling. Select vapor or liquor according to the class of work. Operate fully loaded so that inevitable solvent losses occur with maximum work. Study the mode of packing the work. Have men work in fresh rather than solvent-laden air.

(138) E. W. Myers, "Trichloroethylene Degreasing," *American Mutual Magazine*, Vol. 19, pp. 2–8 (1940); *Review of Current Literature Relating to Paint, Colour, Varnish & Allied Industries*, Vol. 14, p. 166, (1941); *Chemical Abstracts*, Vol. 35, 6349 (1941).

A discussion of principles involved in the proper design of equipment for using and controlling the toxic trichloroethylene vapors.

(139) A. M. Berkenheim and M. A. Berkenheim, "The Application of Emulsion from Shale Products for Cleaning Aluminum," *Aviapromyshlennost*, Vol. 4, No. 3, pp. 122–123 (1941); *Chemical Abstracts*, Vol. 37, 4675 (1943).

Concentrated emulsions of "avtol" and of machine oil were prepared using the sodium salts of shale sulfonic acids and this used to replace kerosene in the mechanical treatment of aluminum. The emulsions contain potassium dichromate as a corrosion inhibitor.

(140) Edward Finnie, "Cleaning Lead Castings Prior to Plating," *Products Finishing*, Vol. 5, No. 11, pp. 60–61 (1941).

Because of the present shortage of zinc for domestic use, the zinc-base die castings are being replaced by 12 to 14 per

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cent antimony-lead castings; this forces platers to change their cleaning cycle to meet the change in casting metal composition. Each of the following five cycles gives satisfactory results: (*1*) Degrease, clean cathodically in a mild cleaner at 70 C. (changing the cleaner often), rinse, soak for 5 min. in a 10 per cent NaCN solution at room temperature, transfer directly to a high-speed copper bath for 5 min. at 35 amp. per sq. ft., rinse, acid dip, and nickel-plate. (*2*) Degrease, clean cathodically in a mild cleaner for 1 min., rinse, dip in 5 per cent by volume AcOH, rinse, copper-strike in a Rochelle salt copper bath at 2 v. or less for 10 min., rinse, acid dip, and copper-or nickel-plate. (*3*) Wash in washing machine, clean anodically in a mild cleaner for 5 to 20 sec., rinse, dip in 3 per cent H_2SO_4 for 2 sec., rinse, copper-strike in a Rochelle salt bath at 10 amp. per sq. ft. for 5 min., rinse, and copper-or nickel-plate. (*4*) Degrease, clean in a mild cleaner cathodically, rinse, reverse current in a 55 deg. Be., bath in H_2SO_4 for 15 to 30 sec., rinse, and copper-strike for 15 to 30 sec. at 5 v. (*5*) Clean cathodically, rinse, soak in hot water for 5 min., and transfer directly to nickel solution.

(*141*) Ernest H. Lyons, Jr., "Contamination and Electrolytic Cleaning of Cold Rolled Steel," *Transactions*, Electrochemical Soc., Vol. 80, pp. 367–386 (1941).

Electrolytic cleaning of oil and dirt from lengths of cold-rolled strip steel is of considerable commercial importance, not only before hot tinning but also preliminary to electroplating the strip. The author discusses solutions, details of design, and operating requirements. From a consideration of the cold rolling operation, it is suggested that thermal decomposition of the coolant oils on the strip is responsible for the very resistant films sometimes noted; adsorption of fatty acids may also be troublesome. These contentions are supported by experimental evidence, by citing experiences in the rolling and electrolytic cleaning of such steel, by conclusions reached by an investigation in an English laboratory, and by analogies. The best conditions for the electrolytic removal of oil and dirt from the steel are indicated.

(*142*) M. E. Parker, "Role of Acid Cleaning Agents in Dairy Detergency," *Milk Plant Monthly*, No. 9, pp. 49–52 (1941).

Alkaline detergents have certain disadvantages when used for churn washing; for example, they give rise to the formation of milkstone, which acts as a nutrient medium with consequent survival of proteolytic and oxidative bacteria. Even when such churns contain large numbers of acid producers, the foul odors are definitely of proteolytic origin. The action of gluconic and levulinic acids injected with the steam into churns previously washed with a reliable alkaline proprietary detergent is definitely superior to that of the alkaline detergent alone. Organic acids such as these give pH 6.0 to 6.5 in the churn, with negligible corrosion. High counts of spoilage bacteria were suppressed, odors eliminated, and clean surfaces obtained.

(*143*) Lewis Shere, "Factors Causing and Methods of Preventing Milkstone Formation," *Milk Dealer*, Vol. 30, No. 6, March, 1941, pp. 33, 56–64.

After discussing briefly the causes of milkstone formation, its control is considered from two angles: (*1*) that of minimizing the formation, and (*2*) proper steps for removing the deposits. General recommendations are made, since different kinds of equipment require different types cleansers.

(*144*) G. Rogner, "Cleaning and Degreasing of Metals Before Applying Organic or Inorganic Coatings," *Korrosion und Metallschutz*, Vol. 17, No. 6, pp. 204–207 (1941); *Journal*, Inst. Metals, Vol. 10, p. 159 (1943).

Elementary account of the principles and methods for degreasing and cleaning metal surfaces with organic solvents, alkaline degreasing baths, electric cleaners, and mechanical methods.

(*145*) Tentative Standards and Recommended Practices and Procedures for Spot Welding of Aluminum Alloys, Am. Welding Soc. (1942).

Surfaces may either be mechanically or chemically cleaned. The first step is removal of extraneous soil followed by removal of the resistance film of oxide so that uniform contact resistance will ensure, providing controlled extent of fusion. Removal of extraneous soil may be accomplished by degreasers or alkaline cleaners. Oxide film may be removed, preferably by acids, since the operation can be controlled more closely than by using caustic soda.

(*146*) "Metal Cleaning as of To-day," *Automotive and Aviation Industries*, Vol. 86, April 1, 1942, pp. 44, 70–75.

"W.P.B. No. 399" release is interpreted as a warning that an impending shortage of chlorinated solvents may make a decided difference in metal cleaning processes in war production plants. The following recommendations are made:

1. W.P.B. release suggests that about 30 per cent of the cleaning operations now being done with chlorinated solvents could be accomplished with the use of other commercially available cleansers such as mineral spirits, alkalies, and nonchlorinated-solvent-water emulsions.

2. Several prominent suppliers of chlorinated solvents and degreasing equipment have ventured the statement that the overloading and overcrowding of machines beyond original capacity cause considerable waste.

3. Focus of attention on the problem should provide a new incentive for a better understanding of metal cleaning in all its ramifications.

Reports from several specialists are summarized, the general opinion being that each plant should make a study of its metal cleaning problems by placing them in the hands of a competent staff metallurgist or chemist. Then follow this with a survey and recommendations by the specialists in the metal cleaning field.

(*147*) C. J. Bushrod, "General Review of Corrosion of Magnesium and Magnesium-Base Alloys," *Magazine Reviews and Abstracts*, Vol. 3, No. 1, pp. 19–26 (1942); *Metal Industries*, Vol. 61, No. 21, pp. 324–326 (1942).

Discusses corrosion resistance of pure magnesium and of magnesium base alloys containing (*a*) manganese, and (*b*) aluminum, zinc, and manganese, toward atmosphere, sea water, acids, and alkalies. Protective processes and precautions are described. Bibliography of 29 references.

(*148*) Wilfred J. Clifford and Henry H. Adams (to The Pyrene Co., Ltd.), "Cleaning Metals or Other Surfaces," British Patent No. 543,770; *Chemical Abstracts*, Vol. 36, 6274 (1942).

The metals or other surface are cleaned by spraying the surface with an aqueous solution of a weak acid or salt at a temperature above 120 F. and stopping the spraying when the surface is clean. The pH of the solution should be between 2.5 and 4. As an acid is used H_3PO_4 or an acid phosphate.

(*149*) C. F. Dinley, "Stabilization of Chlorinated Solvents for Metal Degreasing," *Products Finishing*, Vol. 6, No. 10, pp. 24–26 (1942); *Chemical Abstracts*, Vol. 36, 4931 (1942).

Stabilizers of the organic-base type are soluble in the chlorinated solvent. Volatilize with the solvent vapor during distillation, and condense with the vapor. The boiling point and vaporizing rate of the organic base must be such that the reaction of the chlorinated solvent is always basic regardless of the number of times the solvent undergoes distillation.

(*150*) J. Edgell, "Corrosion of Aluminum Utensils," *The Electric Times*, Vol. 102, pp. 44–45 (1942); *Chemical Abstracts*, Vol. 37, 4042 (1943).

Corrosion was due to galvanic action between the aluminum and traces of copper dissolved from the piping. An anodic finish obtained by immersing the utensil in 5 per cent H_2CrO_4 at about 38 C. provided satisfactory protection.

(*151*) E. R. Irwin and J. Teres, "Metal Finishing for Military Aircraft," *Proceedings*, 30th Annual Convention, Am. Electroplaters' Soc., pp. 134–139 (1942); Discussion, pp. 139–141.

Methods of preparing aluminum and magnesium alloys for surface-protection treatment, such as anodizing, plating, and painting, are described, and brief accounts are given of standard practice in the cadmium plating, lead plating, phosphatizing, and painting of steel.

(*152*) W. F. Jesson, "Solvent Economy in Trichlorethylene Degreasing Plants," *Metal Industry*, Vol. 60, pp. 254–257 (1942); *Metallurgia*, Vol. 25, pp. 177–178 (1942). Originally presented to the Electrodepositors' Tech. Soc.

The development of degreasing plants is reviewed briefly. Recommendations are made for central control of degreas-

ers and practical suggestions outlined for various ways of preventing waste of the solvents.

(153) "Metal Cleaning in War-Time. Magnus Cleaners," Magnus Chemical Co., Garwood, N. J. (1942).

A fifty-page booklet outlining in detail the metal cleaning problems of production for war and indicating the Magnus product best suited for use in each.

(154) Max Metzinger and Alfred Long (to Blockson Chemical Co.), "Detergents Suitable for Use on Metal-Ware with Tin Surfaces," U. S. Patent No. 2,285,676; *Chemical Abstracts*, Vol. 36, 6707 (1942).

A noncaustic alkaline detergent such as Na_2CO_3 and Na_2HPO_4 is used with about 0.5 to 1.5 per cent of a chromate salt of an alkali metal such as $Na_2Cr_2O_7$ and up to 15 per cent of an alkali metal fluosilicate.

(155) L. H. Minor, "Selection of Detergents," *Southern Dairy Products Journal*, Vol. 32, No. 5, November, 1942, pp. 22, 24.

A short discussion of the various types of dairy cleansers concludes that "the wide variation in the mineral content of water along with the many different types of cleaning to be done makes a universal detergent next to impossible." Points that make a satisfactory detergent are: (1) Softens the water; (2) prevents precipitation of water minerals which build film and scale formation; (3) increases the wetting ability of the water; (4) dissolves or softens the milk residues so that they can be removed; (5) does not corrode the metal surfaces of the equipment; (6) does not attack the hands if it is to be used in hand cleaning; (7) is nontoxic; (8) does not encourage development of off-flavors to dairy products; (9) rinses freely; (10) economical to use.

(156) O. M. Morgan and J. G. Lankler, "Evaluation of a Surface Active Agent for Metal Cleaning," *Industrial and Engineering Chemistry*, Vol. 34, pp. 1158–1161 (1942). See reference No. 118.

(157) O. M. Morgan and J. G. Lankler, "Evaluation of Metal-Cleaning Compounds," *Industrial and Engineering Chemistry*, Analytical Edition, Vol. 14, pp. 725–726 (1942). See reference No. 119.

(158) Fred Morris, "Cleaning Alclad for Production," *Aviation*, Vol. 41, April, 1942, pp. 85, 205–206; *Welding Journal*, Vol. 21, April, 1942, pp. 197–198.

One phase of the problem of production spot welding of Alclad involved the development of a method of preparing the surfaces of the metal to secure a satisfactorily low surface resistance between the parts to be welded and to do it consistently. A satisfactory method was developed which permits the parts to be welded at any time within three days after the cleaning operation, and also gives consistent results as far as weld strengths are concerned. The details of the operation are given.

(159) Claudius Nielsen, "Streamlined Cleaning of Metal Surfaces in War Production," *Industrial Finishing*, Vol. 18, No. 2, pp. 31–40 (1942).

Examples are given in which trisodium phosphate is used. Suggests compositions to be tested at 6 oz. per gal. at 212 F. Panels dipped in SAE No. 50 lubricating oil, removed, drained 1 hr. at room temperature, then immersed in boiling cleaning solution. Must also strip zinc chromate primer and lacquer without attacking aluminum. Gives two formulas, one for power washers and one for still tanks.

(160) T. E. Piper, "Preparation of Aluminum Alloy for Spot Welding," *Welding Journal*, Am. Welding Soc., Vol. 21, No. 10, pp. 661–664 (1942); *Journal*, Inst. Metals, Vol. 10, p. 61 (1943).

Describes method for cleaning and etching of aluminum alloy assemblies as a unit, using phosphoric acid with a cleaning agent.

(161) R. S. Pratt, "Heat-Treating Brass Cartridge Cases," *Steel*, Vol. 111, No. 9, pp. 48–49 (1942).

Curves show mechanical properties resulting from various combinations of cold working and annealing. Cleaning with alkalies is necessary to prevent corrosion by powder stored within the case in fixed ammunition.

(162) Gilbert Robinson, "Hot-dip Galvanizing Technique. Part III: Soap Removing and Degreasing," *Wire Industry*, Vol. 9, pp. 373–375 (1942); *Chemical Abstracts*, Vol. 36, 6991 (1942).

A schematic drawing of a continuous hard soap drawn-wire degreasing bath is shown and features of the degreasing bath and the daily solution check are discussed.

(163) Lewis Shere, "How to Prevent and Remove Milk Deposits," *Food Industries*, Vol. 14, July, 1942, pp. 63–66.

Describes suitable cleansing routine to remove milkstone deposits and prevent their subsequent deposition.

(164) Henry Strow, "Metal Cleaning in Wartime," *Monthly Review*, Am. Electroplaters' Soc., Vol. 29, pp. 995–1002 (1942).

Two basic cleaning problems for aluminum prior to spot welding are preparation for anodizing and for welding. Attack on metal is controlled to give slight attack to help in carbonized oil removal. For frosted finishes strong alkalies are used and the degree of etch is controlled carefully. Nitric acid has been used to remove the black smut from aluminum, after treatment in alkali, and addition agents have been marketed to give a clear white color to the surface. In spot welding the oil and grease must first be removed, then the oxide film is acid removed. Magnesium is cleaned by "steel" cleaners because of its resistance to alkali.

(165) J. F. J. Thomas, "Inhibition of Corrosion of Aluminum and Other Metals in Soda Ash," *Canadian Journal of Research*, Vol. 21, No. 2, B, pp. 43–53 (1942); *Metal Abstracts*, Vol. 9, p. 280 (1942); *Journal*, Inst. Metals, Vol. 10, p. 211 (1943).

Immersion for two hours at 60 C. in solutions of soda ash to which are added various inhibitors, total salt concentration of 0.5 per cent. Inhibitors were various sodium silicates, sodium silico fluoride, organic bodies.

Sodium ortho silicate no inhibiting effect on aluminum or duralumin, sodium meta silicate (Metso) gave complete freedom when concentration was 17.5 per cent and upwards of total concentration. Sodium silico fluoride effective at 7.5 per cent and upwards of total concentration.

Attack of galvanized iron inhibitedby metasilicate, but not by silico-fluoride. Higher concentration of silico-fluoride (40 to 60 per cent) needed for tin plate. At higher temperatures higher percentages of inhibitor are needed.

(166) J. F. J. Thomas, "Corrosion Resistance," *Canadian Chemistry*, Vol. 26, pp. 169–171 (1942); *Journal*, Inst. Metals, Vol. 10, p. 15 (1943).

Investigation of laboratory corrosion test methods. Interpretation of laboratory results for actual service conditions discussed. Types of attack on various metals considered, with specific reference to aluminum alloys. Inhibition of corrosion investigated and methods of protection of various alloys recommended.

(167) "Proposed Methods of Chemical Analysis of Industrial Metal Cleaning Compositions," *Proceedings*, Am. Soc. Testing Mats., Vol. 42, pp. 407–422 (1942).

Suggested methods of analysis are proposed, as a means for chemical evaluation and control of cleaning compositions.

(168) S. H. Barmasel, "Surface Protection of Magnesium," *Iron Age*, Vol. 151, No. 16, pp. 44A–44D, 1943; *Chemical Abstracts*, Vol. 37, 3387 (1943).

Any of the well-known methods of solvent or alkali cleaning can be used to degrease magnesium surfaces. Alkaline cleaning can be accomplished either by boiling or by a cathodic electrolytic process in an alkaline solution. The following solution is recommended: 4 oz. of Na_3PO_4, 4 oz. of Na_2CO_3, and H_2O to make 1 gal. This solution should be kept at 194 to 212 F. when in use, and can be used without agitation and at temperatures below the boiling point in the electrolytic cleaning process. The magnesium object is the cathode, current density is 10 to 20 amp. per sq. ft. For solvent cleaning, gasoline, trichloroethylene, naphtha, and CCl_4 are good. Alkaline solutions containing soap should not be used unless the magnesium surface is subsequently to receive a dichromate treatment. When exposure to sea air or saline solutions is expected, chemical surface protection should be provided. For this purpose the magnesium part can be dipped in a solution containing 1.5 lb. $Na_2Cr_2O_7$, 1.5 pt. concentrated HNO_3, and H_2O to make 1 gal., used at room temperature or up to 150 F. if desired. The time required is 30 sec. to 2 min., depending on the age of the solution. After this treatment the part should drain for 5 to 20 sec., and be rinsed in

cold water to 180 F. If the time of dipping has been correct, the magnesium will have a yellow or a red-yellow iridescent hue. The dipping solution can be revived by addition of HNO_3. Resistance of magnesium alloys to salt water is considerably increased if the metal parts are simply boiled for 45 min., in a 10 per cent dichromate solution. This can be preceded by a dip in 15 to 20 per cent HF solution. Dichromate treatment should not be applied to alloys containing manganese. When the alloys contain magnesium they should be anodized. They are first given a dip in HF solution, washed in cold water, and then anodized at 2 to 10 amp. per sq. ft. in a bath containing 3 per cent $(NH_4)_2SO_4$, 3 per cent $Na_2Cr_2O_7$, and 0.25 per cent NH_4OH (sp. gr. 0.880). After this treatment the parts are boiled for five or more minutes in H_2O containing 1 per cent As_2O_3 by weight. This gives a black or dark brown coat.

(169) F. A. Champion, "New Methods for the Examination of Corroded Metals," *Journal*, Inst. Metals, Vol. 10, pp. 47–66 (1943).

Scheme of classification:

- General corrosion
  - even
  - uneven
- Local corrosion
  - even
  - uneven pitting
    - wide
    - medium
    - narrow
  - cracking

Used macro and microscopic means for the observation with charts for comparison.

Description of radiographic means for examination and application of photometric measurement of corroded area. Neither fully exploited as yet, but their use offers quantitative means for measurement.

(170) T. J. Coleman (to Canadian National Carbon Co., Ltd.), "Metal-Cleaning Composition," Canadian Patent No. 412,896 (1943); *Chemical Abstracts*, Vol. 37, 5522 (1943).

A composition for removing scale, oxide impurities, grease, and oil from metal surfaces while preventing acid attack on surfaces of aluminum, brass, copper, tin, and antimony consists of a mixture of about 85 per cent of a water-soluble bisulfate, 6 per cent of a water-soluble organic sulfonation product, 5 per cent of a water-soluble sulfate, and about 4 per cent of $(NH_4)_2HPO_4$.

(171) Herbert K. De Long (to The Dow Chemical Co.), "Cleaning Rolled Magnesium Articles," U. S. Patent No. 2,302,939; *Chemical Abstracts*, Vol. 37, 2332 (1943).

A method is employed for removing carbonized oil containing oxide mill scale from the surfaces of rolled articles of magnesium and magnesium alloys which involves subjecting the article to the action of an aqueous solution of a water-soluble organic carboxylic acid such as acetic, citric, or tartaric acid for a time sufficient to remove the scale but insufficient to permit any substantial attack on the metal.

(172) A. Douty and E. Snyder, "Cleaning Steel for Finishing," *Metal Finishing*, Vol. 41, No. 11, pp. 754–757 (1943).

"Clean" surfaces may have visible contaminants removed, but invisible contaminants, as from alkaline materials in the rinse bath, may remain and ruin adhesion of painted coatings. Even undiscolored, silvery white surfaces while still damp should be suspected. Invisible contaminants, classified as immediately and latently harmful materials, may be:

1. Alkalies and alkaline salts.
2. Alkaline earth metals (hard water).
3. Salts of iron, such as chlorides and sulfates from pickling operations.

Cleaning methods and relative merits:

A. Mechanical.—*Pits not cleaned.*

B. Vapor Degreasing.—Leaves film of iron chloride.

C. HCl or Sulfuric Acid Pickling.—Iron salts remain as a rust. "Blush" unless given final rinse in alkali.

D. Alkaline Cleaning.—Traces remaining deleterious to paint life.

E. Phosphoric Acid Type Cleaning.—Highly desirable because traces of remaining phosphoric acid are beneficial to paint life.

Final rinse is highly important and simple tap water rinse is never satisfactory. Proper rinsing conditions given as follows:

1. Contain either phosphoric acid or chromic acid in very dilute solutions in 0.01 to 0.10 per cent concentration.
2. pH value between 3 and 5.
3. Presence of a suitable agent to cause suitable draining of rinse water.
4. Should be controlled to contain minimum amount of soluble iron salts.
5. Should be hot, preferably boiling and articles left in long enough to attain this temperature.
6. Arrange work for complete drainage.
7. If work does not dry immediately after removal it should be artificially dried.

(173) A. Edeler, "Ground Glass for Spot Testing in Solvent Extractions," *Industrial and Engineering Chemistry*, Analytical Edition, Vol. 15, p. 282 (1943).

Depends upon spot or line produced when a solvent containing oil is allowed to evaporate on ground glass plate of photographic grade. Sensitivity of 0.005 per cent. Test surface gives a transparent spot or circular hair line.

(174) "Cleaners for Effective Metal Cleaning," *Bulletin C-105*, Hanson-VanWinkle-Munning Co. (1943).

Describes laboratory apparatus for the evaluation of either soak or electrified cleaners. The equipment provides for positive circulation (by pump) and an overflow bath. Recommends a titration method for determining the effective remaining alkali in the cleaning bath. Use of a laboratory centrifuge (to remove insoluble soil from the used cleaning bath), the control cleaning apparatus, and the titration analysis serve to decide the period at which the bath should be discarded. The effects of variation of current density, temperature, and concentration upon the cleaning rate of electric cleaning are illustrated.

(175) H. O. Klinke, "Surface Treatment of Aluminum Alloy Assemblies Prior to Spot Welding," *Welding Journal*, Vol. 22, August, 1943, pp. 602–604.

It is desirable to treat the surface of aluminum alloy assemblies rather than the individual components, and a series of tests to determine the production possibilities is described. The aluminum alloy parts were held by a few rivets or small bolts and cleaned at room temperature in a phosphoric acid solution (50 per cent nominal) plus a wetting agent. Spot welds made after such cleaning gave satisfactory test figures, and it was apparent that the solution crept between the faying surfaces. Contact resistances were measured and curves reproduced for Alclad 24S-T assemblies for 0.064 and 0.030-in. material.

(176) Vernon A. Lamb, "Cleaning and Pickling," *Metals and Alloys*, Vol. 17, January, 1943, pp. 86–87.

A review of developments during 1943, with a bibliography of 17 references.

(177) P. D. Liddiard, "Determining the Cleanliness of a Metal," *Metal Industry*, Vol. 63, August 27, 1943, pp. 130–131.

Tests developed and used in the study of degreasants are summarized. Although many of them are applicable in certain circumstances, they will, nonetheless, be of considerable interest to those engaged in the treatment of metal surfaces. The term "degreasing" is defined and considered in two stages: (*1*) the removal of surface deposits of oil from the solid surface and (*2*) the removal of adsorbed layers of oil. Tests for grease freedom are discussed under headings: Direct observation; surface tension; selective staining; solvents; decomposition; and electroplating. A brief reference is made to the residues of degreasants.

(178) R. B. Mears and G. G. Eldredge, "The Use of Inhibitors for Aluminum Chemical Equipment," *Transactions*, Electrochemical Soc., Vol. 83, 15 pages (1943).

A classification of inhibitors according to their effectiveness and their influence on the intensity and area attacked is given. The electrochemical behavior of inhibitors is discussed and the factors that cause an inhibitor to be safe or dangerous are outlined. A series of laboratory tests to determine the effectiveness of various chemicals as inhibitors of the attack of aluminum and the aluminum-base alloys in acid, alkaline, and neutral solutions are described. Organic substances such as soluble oils, alkaloids, and organic sulfur compounds proved to be effective inhibitors in HCl. Chromates, soluble oils, and commercial

wetting agents appeared to be the best in H_3PO_4. No highly effective inhibitors for H_2SO_4 were found. In alkaline solutions, the silicates were the most promising inhibitors. Chromates and soluble oils were the most effective inhibitors found for nearly neutral solutions. However, even these substances were not effective for preventing galvanic attack by waters containing appreciable concentrations of chlorides. Service applications of inhibitors for protecting aluminum chemical equipment are described, particular attention being given to the inhibiting action of an alcohol cooling fluid. Hot Na_2CO_3 solutions require 22 per cent by weight of $Na_20.2SiO_2$. Hot Na_3PO_4 solutions require 30 per cent by weight of $Na_20.2SiO_2$.

(179) Oliver M. Morgan (to Allied Chemical & Dye Corp.), "Cleaning Metal Surfaces such as Those of Iron or Steel," U.S. Patent No. 2,314,285 (1943); *Chemical Abstracts*, Vol. 37, 5010[4] (1943).

For removing greasy residues, the metal to be cleaned is immersed in a hot aqueous alkaline cleansing bath such as one of NaOH, Na_3PO_4, Na_2CO_3, and Na_2SiO_3 containing, per gallon of water, 0.125 to 1.0 oz. of Na heptyl-naphthosulfonate or other alkyl aromatic sulfonate having at least 7 C atoms in an alkyl radical, as a cleansing assistant and as an emulsifying agent for the residues, while an electric current is passed through the metal as an electrode.

(180) R. W. Mitchell and Marcel T. Zinty, "Metal-Cleaning Solutions. What They Are, How to Use Them, and Why," *Machinist*, European Edition, Vol. 87, pp. 105–107 (1943).

Metal cleaning solutions are grouped into four major classes: Alkaline cleaners, solvent cleaners, petroleum spirit cleaners, and the newest development, emulsifiable cleaners. The advantages and disadvantages of each, and its ability to meet the requirements of a metal cleaner, are described.

(181) M. E. Parker, "Acid Detergents in Food Sanitation," *Industrial and Engineering Chemistry*, Vol. 35, January, 1943, pp. 100–105.

The discovery of organic acids with relatively low corrosiveness and inherent inhibiting effects upon the quality-defective types of microorganisms first pointed the way to developing acceptable types of acid cleaners. The effective combination of such acids with surface-active agents and corrosion retarders has resulted in the development of acid cleaning compounds possessing a detergency superior to that of most alkaline products, as well as providing an incidental wash water treatment, both corrective and curative, for the problem of water-stone and other calcareous formations. Therefore, acid cleaners promise not only a revision but an even greater improvement in the sanitary practices of food industries.

(182) M. E. Parker, "Manual of Dairy Detergents and Cleaning Practices," *Food Industries*, Vol. 15, July, 1943, pp. 78–80, 135; August, 1943, pp. 71–72, 131; September, 1943, pp. 66–67.

Part I discusses the attributes and shortcomings of the various types of dairy washing compounds. A table giving average water hardness in the United States and Canada is included in this part. Part II considers wetting agents, polyphosphates, and abrasives. The trade names and manufacturers of dairy cleaners are listed. Part III gives practical directions for cleaning cream cans, separators, and farm utensils. These include step-by-step instructions for this important phase of dairy sanitation.

(183) H. P. Quadland, "Industrial Degreasing Agents," *Metal Finishing*, Vol. 41, July, 1943, pp. 463–465; *Metal Industry*, Vol. 63, p. 220 (1943).

A short review of fire and explosion hazards, toxicity, availability, and costs involved in the principal methods of degreasing.

(184) Campbell Rutledge, Jr. (to General Chemical Co.), "Detergent Composition," Canadian Patent No. 411,280 (1943).

A detergent, particularly for aluminum and tin articles, consists of an aqueous solution of Na_3PO_4, Na_2SO_3, and sodium silicate having a SiO_2, Na_2O ratio of 2 to 4. Strips of aluminum weighed, then immersed in the cleaner solution at 150 F. for $\frac{1}{2}$ hr. in solution from 0.10 to 5.00 per cent by weight. The strips then are removed, weighed, and loss calculated in milligrams per square inch per $\frac{1}{2}$ hr. at 150 F.

(185) Ray Sanders, "Chemicals That Aid in Aircraft Production," *S.A.E. Journal*, Vol. 51, January, 1943, pp. 23–30.

Methods for protecting alloys 17S-T, 24S-T, and Alclad 24S-T from corrosion and the determination of the relative adhesion of paints on the same alloys including a discussion of cleaning treatments. The value of precleaning in removing the greater part of the soil, oils, and lubricants before entering the final cleaning tanks is pointed out. Emulsion degreasing, vapor degreasing, mechanical washing machines, and auxiliary hot tanks are also discussed. The differences in cleaning and treating methods to be employed with aluminum and magnesium alloys are brought out and the preparation of steel, copper, or brass for cadmium plating and of aluminum alloys for spot welding is discussed at some length.

(186) W. S. Simmie, "Inspection of Cleaning Methods for Light Alloy Sheets," *Welding*, Vol. 11, November, 1943, pp. 462–463.

Aluminum alloy sheets required to be cleaned prior to spot welding and also in order to obtain a surface to which paint will adhere. Chemical methods are used largely for such pretreatment, and a new method of testing the efficacy of the treatment is described. The apparatus consists of a low-reading cross-coil ohmmeter, a 10-amp. 2-v. battery, and a pair of copper electrodes, the bottom die being fixed and the upper capable of controlled movement. The test piece is placed between the electrodes and the resistance is measured. Typical results are included.

(187) Robert Sizelove, "Development of Cleaning Materials in 1942," *Monthly Review*, Am. Electroplaters' Soc., Vol. 30, pp. 54-56 (1943).

Shell fuse parts of aluminum cleaned either by degreasing or by mild alkali soaking. Alkalies preferable because of deleterious action of aluminum upon degreasing solvent, but this may be eliminated by proper operation of the degreaser.

(188) Maxwell Stiles, "Cleaning Steel, Brass, Bronze, and Copper," *Industrial Finishing*, Vol. 19, No. 4, pp. 38–48; No. 6, pp. 14–18 (1943).

Directions are given for cleaning steel, magnesium alloys, brass, bronze, and copper, using the electrolytic cleaning method, sandblasting, brushing, pickling, vapor degreasing, passivating treatment, and hydrocarbon and aqueous solvents. Aluminum cleaned prior to anodic treatment in an inhibited alkaline cleaning preparation, then through a hot water rinse, through the chromatizing or anodizing bath, followed by a final rinse (containing chromic acid for neutralization), then to a drying station. In other cleaning processes the final rinse is neutralized and the pH of the rinse water is held below 6.8 by use of chromic acid. Details are given for cleaning procedures prior to other operations such as welding or paint coating.

(189) Henry Strow, "Evaluation of Metal Cleaners," *Metals and Alloys*, Vol. 18, September, 1943, pp. 503–505.

Significant factors for evaluating cleaning efficiency are considered briefly under pH, emulsifying power, surface tension, and buffering action. The test for cleaners recently developed by Morgan and Lankler is described briefly as being the most satisfactory at the present time. Determination of the life of a metal cleanser is also an evaluating factor.

(190) F. W. Van Antwerpen, "Surface Active Agents Manufactured in America and Commercially Available," *Industrial and Engineering Chemistry*, Vol. 35, January, 1943, pp. 126–130.

A tabulated list which has appeared before in this journal. See Vol. 31, January, 1939, pp. 66–69 and Vol. 33, January, 1941, pp. 16–22.

(191) Camille Dreyfus, Canadian Patent No. 416,965; *Soap*, Vol. 20, No. 2, p. 67 (1944).

A liquid for cleaning aluminum contains 6 to 25 parts of soda alum, 0.2 to 5.0 parts of a detergent, and about 100 parts water.

(192) Compound, Cleaning; For Painted Surfaces, Bureau of Ships Ad Interim Specification 51C20 (INT).

Tests include measurement of reduction in gloss of painted panels, and the photometric measurement of cleaning efficiency utilizing a special washability apparatus. A standard soil comprising metallic brown, kerosene, carbon tetrachloride, Nujol, forced-feed lubri-

cating oil, and hydrogenated vegetable shortening is applied to panels, baked at 100 to 105 C. for ½ hr.

(193) Detergent, Dishwashing, Bureau of Ships Ad Interim Specification 51D8 (INT).

Corrosion tests for aluminum alloy sheet.

(194) Ether, Alkylated, Phenolic (For Cleaning Aircraft), Navy Aeronautical Specification RM-70, February 7, 1938.

Evaluation of interfacial tension, deflocculation of Norit carbon, stability, and panel tests with aluminum alloy sheet.

(195) Compound, Cleaning: Aircraft, Air Corps Specification No. 20015-B, October 12, 1940.

Tests compound with 24S-T aluminum alloy for corrosion resistance, cleaning power against a composition comprising asphalt, aircraft engine oil, kerosene, xylene, and powdered rottenstone which is baked at 143 to 150 C. for 3 hr. Also includes a rinsing test.

(196) Cleaner, Alkaline, Heavy Duty for Hot Tank Parts and Radiator Cleaning, Holabird Ordnance Motor Base Specification ES-382a, February 6, 1941.

Includes solubility and rinse tests.

(197) Compound, Paint Stripping, Noninflammable, Navy Aeronautical Specification C-113, September 22, 1941.

Tests include stripping properties, and corrosiveness.

(198) Compound, Paint Stripping (Silicate Type), Navy Aeronautical Specification C-67d, September 23, 1941.

Tests include stripping and rinsing properties.

(199) Paint, Stripper, Alkali, Tank-Automotive Center, Tentative Specification ES-No. 452a, February 6, 1941.

Tests include surface tension, hydrogen-ion concentration, rinsing, solubility, and stability.

(200) Cleaner, Metal Silicate-Soap, Navy Aeronautical Specification C-109a, March 31, 1942.

Tests include: Surface properties, solubility, cleaning properties (against mineral oil on an aluminum panel), rinsing properties, and corrosiveness.

(201) Compound, Carbon Removal for Aircraft Engine Parts (Cresol Type), Navy Aeronautical Specification C-86b, June 24, 1942.

Corrosion test for anodized aluminum alloy, polished aluminum alloy, polished copper, and steel strips. An enamel and varnish stripping test is outlined, as is a test for evaluating the removal of S.A.E. No. 50 oil. A test for rinsability is included.

(202) Compound, Carbon Removal, for Aircraft Engine Parts, Navy Aeronautical Specification C-118, May 16, 1942.

Tests include corrosiveness, carbon removal from a heavily carbonized aluminum alloy piston, oil removal properties (S.A.E. No. 50 oil), and rinsing properties.

(203) Compound, Carbon Removal (for Engine Parts), Army Air Force Specification No. 20025, June 15, 1942.

Carbon removal test from a portion of a carbon-covered aircraft engine piston, and a corrosion test.

(204) Compound, Engine Cleaning and Paint Stripping, Navy Aeronautical Specification C-114, Amendment 1, March 10, 1942.

Tests include corrosiveness, stripping properties, rinsing properties, oil removal (S.A.E. No. 50 oil), and carbon removal from a carbonized aluminum piston.

(205) Compound, Grease-Cleaning, Solvent-Emulsion-Type, Federal Specification P-C-576, November 6, 1942.

Includes stability and kerosene and water solubility tests. Aluminum panels are treated with an S.A.E. No. 70 lubricating oil to which sufficient talcum powder is added to form a paste. The panels are then baked at a temperature of 290 to 300 F. for 3 hr., cooled, then cleaned under standard conditions.

(206) Metal Conditioner, Acid, Concentrated, Tank-Automotive Center, Tentative Specification HQMB ES-No. 431b, August 7, 1942

Includes tests for sedimentation, flash point, and etching action.

(207) Cleaner, Carburetor, Tank-Automotive Center, Tentative Specification TAC ES-No. 645a, March 17, 1943.

Includes corrosion, solubility, emulsification, and homogeneity tests.

(208) Compound, Vapor Cleaning, Tank-Automotive Center, Tentative Specification TAC ES-No. 542b, May 1, 1943.

Includes tests for insoluble matter, solubility, solution stability, stability at 75 C., water softening ability, surface tension, hydrogen-ion concentration, and rinsing properties.

(209) Corrosion Prevention; Processing and Packaging, Ordnance Department Tentative Specification TM 38-305, August 1, 1943.

A 60-page specification which includes instructions for solvent cleaning by immersion, spray, vapor degreasing, and removal of perspiration and similar residues. Alkaline cleaning specifications include immersion cleaning using formulas exemplified by the following:

85 per cent Sodium orthosilicate
10 per cent Sodium carbonate (anhydrous
5 per cent Sodium resinate

II

46 per cent Sodium carbonate (anhydrous)
32 per cent Trisodium phosphate
16 per cent Sodium hydroxide
6 per cent Rosin

Alkaline spray cleaning can be done with single compounds such as:

Sodium orthosilicate,
Sodium metasilicate,
Tetrasodium pyrophosphate, and
Trisodium phosphate.

Alkaline electrocleaning can be carried out using formulations I or II above, for alkaline immersion cleaning.

Emulsion spray cleaning and emulsifiable solvent soak cleaning methods and precautions are described.

Directions include sections on general directions, materials and control conditions, control and operation of rinses, and procedure for cleaning.

Specific precautions are given regarding the cleaning of aluminum, magnesium, zinc, and their alloys by alkaline cleansers.

"Materials Standardization"

S. B. Ashkinazy, Standards Engineer, Materials and Processes, Sperry Gyroscope Co., Inc., has prepared an interesting article in the April issue of *Mechanical Engineering*. In it he describes various practices of his organization and reproduces forms which are used to record and disseminate to all in the plant concerned, pertinent information on materials being purchased. He refers to the A.S.T.M. and includes quite a number of references to Society publications in his bibliography. His list of advantages of standardization reproduced below stresses once again the importance of work in this field and the value of it.

Advantages of Standardization

1. It sets up a uniform system for everybody to follow.
2. It guides those concerned with specifying, requisitioning, purchasing, stocking, and inspecting of materials.
3. It permits the specification of materials on drawings in such a manner that changes in them will not require changes in drawings.
4. It permits the exercise of proper control over the quality of materials.
5. It establishes standards of quality and effectiveness of the finished product.
6. It confines use of materials to as few as possible, based on functional requirements rather than individual preferences.
7. It simplifies records kept throughout the company as there are fewer types, sizes, etc., to be recorded.
8. It avoids lost motion and confusion in requisitioning and purchasing of materials.
9. It permits the purchasing of fewer items and in greater quantities for best economy.
10. It reduces the amount of capital tied up in inventory.
11. It simplifies storage.
12. It reduces manufacturing costs.
13. It shortens fabrication time.
14. It eliminates duplication of effort.
15. It eliminates waste.
16. It facilitates design and development work.
17. It stimulates research and makes for the elimination of antiquated methods and materials.
18. It reduces cost and time of instruction of new employees.

Standards in Post-War World Discussed at Toronto Meeting

At a most interesting meeting arranged by the Affiliated Engineering and Allied Societies in Ontario held on Tuesday, May 9, in Toronto, three informative addresses were given by J. B. Carswell, O.B.E., President of the Canadian War Assets Corp.; Col. W. R. McCaffrey, Secretary, Canadian Engineering Standards Assn., and C. L. Warwick, Secretary-Treasurer, A.S.T.M. Dr. O. W. Ellis, Director, Department of Engineering and Metallurgy, Ontario Research Foundation, who is President of the Affiliated Engineering and Allied Societies, and also vice-chairman of the A.S.T.M. Western New York-Ontario District Committee, arranged the program, and presided at the meeting. Prof. E. L. Allcut, Vice-President of the Affiliated Group, led the discussion period.

Preceding the technical meeting, which was attended by upwards of 250 engineers and technical people, there was an informal dinner of the officers of the various professional and other societies, at which the speakers were also present, this being held in the beautiful Hart House at the University of Toronto which combines recreational, social, library, and athletic facilities. The meeting itself was in the McLennan Laboratory, Physics Building. The general topic, "Engineering Standards in the Post-War World," is one of vital interest to the engineering profession—this was evidenced by some of the interesting discussion and by the close attention given each of the speakers.

Mr. Carswell, who occupies one of Canada's most important positions, and who, after his retirement abroad, just managed to get out of France and was called into service for his country again, delivered a most thought-provoking and stimulating address. It was particularly pertinent because, although he is a former engineer and technical man (it was of interest to discover that he had formerly been active in certain A.S.T.M. work), he was viewing the standards movement from a definitely objective point of view. He praised the engineering fraternity for progress that has been made in the standardization movement which received much of its stimulus during the first world war, *but* he asked the general question "What about the wastage in the following two decades when so many uneconomic practices again came into being, many to go overboard again with the current war effort?" In short, perhaps those responsible should not be too self-satisfied when the over-all picture is evaluated. Why this post-war decline in what is agreed are important constructive movements—standardization and simplification? He suggested apathy, ignorance, and distorted selfishness as being important responsible factors.

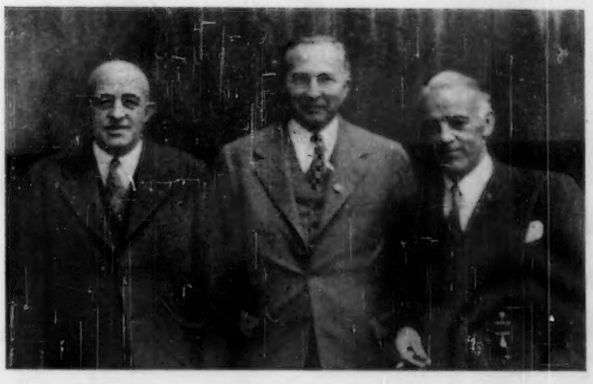
His remarks on the conditions that will affect the extension of the standards movement now, and post-war, were the more effective because of his great responsibility in the War Assets Corp. which is responsible for the billions of dollars woth of material that will remain after the war, including buildings, machinery, ordnance, etc. The enemies of standardization, or the forces against it, he listed as (1) ignorance, (2) fear, (3) selfishness, (4) individuality; and those definitely on the favorable side as (1) common sense, (2) economy, (3) universal brotherhood. To achieve universal standardization, which is the broad aim, he felt that ignorance was not as formidable as some of the others; that the engineering and technical profession can, if it chooses, overcome this factor; but fear—industrial and national fear—is a most perplexing and serious obstacle. Why, for example, should the military forces of Canada and the United States be using small arms ammunition having a small caliber difference? He asked pointed questions about air policy; the necessity of interchangeability of parts from the commercial airline angle, etc.

Selfishness, being a brother of fear, had somewhat the same implications, and on the involved question of individuality, he felt standards certainly could be stimulated without blocking progress or the ability of one organization to incorporate into its product more quality or improvements than a competitor and still be in the standardization fold. Mr. Carswell strongly advocated that standards movements be on a voluntary basis and not under the control of government. He feels that example is better than precept. The present war has exposed many wasteful practices, but the future is bright since many industries are new and if handled with common sense and wisdom their practices in standardization and simplification can be inculated, much as knowledge and wisdom are in a child. He concluded with the warning that standards should not clash with obsolescence.

Dr. F. O. Clements many years ago expressed the similar idea: "Let's standardize materials and processes, but be very careful not to standardize our minds. Standardization must be the servant, not the master."

Colonel McCaffrey's Remarks:

Col. W. R. McCaffrey, a graduate of the University where he was speaking, and who served in the Canadian Artillery in the first war, following which he was in building construction work for some 16 or 17 years, and Secretary of the Canadian Standards Association since 1937, presented a clear description of the activities of CSA, discussed its development, and also the relation of Canada to the international standards picture. Starting in the first world war, CSA received impetus as a result of the 1930 Imperial Conference and although it has received financial support from the government, it is an autonomous body, but in certain phases of its work it is tied in with the National Research Council, a government organization administered by a main committee of about 100 appointees with a smaller executive group of some 20



Messrs. McCaffrey, Warwick and Carswell

individuals, some 200 important standards have been issued, among the most important of which is the Canadian Electrical Code. This code is mandatory throughout the country. There is a government requirement that the CSA standards must be used in purchasing for federal needs.

He described one of the newer developments, the Approval Division, which is somewhat similar to the Underwriters' Laboratories work in this country, granting labels of inspection which, however, are not grading. He referred to the cooperation between A.S.T.M. and the A.S.A. and the British Standards Institute. In connection with international standards and particularly the United Nations' Standards Coordinating Committee, which is now getting under way, with secretarys' offices in both New York and London, he expressed his feelings that there were certainly some problems where constructive work could be done, including screw threads, food containers, and other shipping containers, farm implements, various materials needed for rehabilitation, aircraft parts, and others.

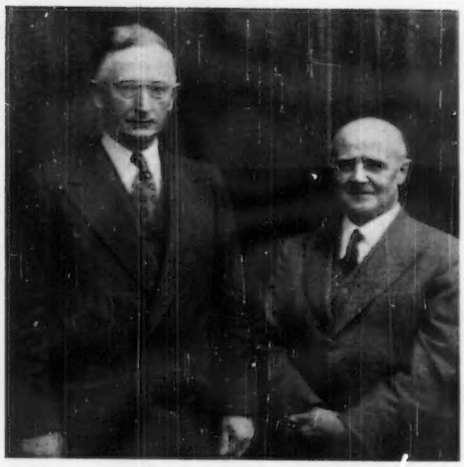
Following his address Colonel McCaffrey announced an interesting development, namely, an extension of the scope by the Canadian Government which changes the name of The Canadian Engineering Standards Association to the Canadian Standards Association, thus extending its work beyond engineering. This reflects the growing interest in consumer goods and related materials.

Mr. Warwick's Talk—A.S.T.M. and Post-War Standards

In describing the contribution of the A.S.T.M. in the field of post-war standardization, Mr. Warwick, after expressing his pleasure at being invited to address the Affiliated Engineering Societies and the Ontario members of A.S.T.M., gave a compact description of how the Society was organized and how it functions. He stressed the uniqueness of the organization in coupling so closely the development of knowledge of materials, through research, and standardization activities, an arrangement which no other standards organization had. He pointed out that the Government, through active participation in technical committees by representatives of various departments and bureaus, and through purchase of specifications, and publications, and in other ways, recognizes the significance and ably supports the Society's work. He stressed the committee structure as being the backbone of the Society with 2000 members, out of 5000 in the Society serving on the technical groups, many of which are really small societies within themselves.

Then, in relating A.S.T.M. activities to postwar standardization, he referred to the constant changes in the materials field, the competition of various industries and materials, and stressed some of the newer products which are coming into the Society's studies: plywoods, plastics, synthetic rubbers, powdered metals, and modified materials such as "compreg," a product formed by impregnating wood with certain resins under pressure, etc. He pointed out the trend in combinations of materials such as textiles and plastics, wood and resins, metal and rubber, which will introduce many new technical or testing and specification problems.

Mr. Warwick stressed that A.S.T.M. was trying to prepare itself for whatever the future might hold, especially in the materials problems of new and rapidly growing industries such as aircraft, electronics and plastics, and referred to the deliberations of the Study Committee now under way. As a result of his work in the War Production Board and as administrator of the National Emergency Steel Specifications Project, he has been convinced that we must keep all gains applicable to peacetime that are represented in present war standards.



W. P. Dobson, Hydro-Electric Power Commission of Ontario, and O. W. Ellis. Mr. Dobson introduced Mr. McCaffrey; J. G. Morrow presented Mr. Warwick; and Dr. Ellis introduced Mr. Carswell.

He also discussed the international aspects of postwar standardization. He first pointed out the value of participation by our Canadian members in A.S.T.M. standardization activities which have helped bring American and Canadian material standards closer together. He then touched on the relations of A.S.T.M. and the American Standards Association, stressing the significance of the latter as a federation of standardizing bodies in the United States to coordinate American standardization activities and to act as the official channel of America's participation in international standardization. A.S.T.M., while working through A.S.A. in these official channels, also maintains direct cooperative relations with its counterpart organizations in other countries.

He endorsed the purposes for which the United Nations Standards Coordinating Committee is being formed, urging that all United Nations be invited to participate in this movement. He suggested that adoption of international standards frequently involves more than merely technical matters and that industrial, economic, and political considerations must be appropriately taken into account in final decisions.

Summarizing, he stated that A.S.T.M. is preparing to meet postwar problems, and to continue to serve its members, industry, and Government with increased effectiveness. The Society is prepared to collaborate with the Canadian Standards Association on all standardization problems of mutual interest and to do whatever it can toward wise and effective international standardization.

Allan Bates Speaks in Cleveland on "What of Engineering Materials in the Future?"

Dr. A. Allan Bates, Manager of Chemical and Metallurgical Dept., Research Laboratories, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., was the principal speaker at the meeting sponsored by the A.S.T.M. Cleveland District Committee on April 14 on the topic, "What of Engineering Materials in the Future?" The Society's President, Dean Harvey, spoke, and greetings from Headquarters were extended by R. J. Painter, Assistant to the Secretary. The attendance totaled about 140. Preceding the technical meeting which was held in the well-equipped lecture hall of the Cleveland Engineering Society, there was an informal dinner of the District Committee and guests.

In developing his thesis, Dr. Bates reviewed the general over-all raw materials that are available, stressing the abundance of three strategic materials—iron, aluminum, and magnesium. He then selected plastics as a new group for many of whose families, the raw materials are limitless. He exhibited many of the interesting products fabricated from plastics. Finally he pointed out that with the development of some of the relatively newer materials, aluminum for example, there had been no diminution in use of steel. While it is quite possible there may be important changes in the relative significance of certain materials, one left the meeting with the impression based on his remarks that we might expect that the many important new materials which would develop would not necessarily replace older ones, but perhaps in many cases even stimulate their use.

During the question-and-answer period, he outlined some of his reactions on five months spent as visiting Professor of Metallurgy at the Sao Paulo Technical Institute. He commented on the raw materials situation in Brazil, some of the technical, educational, and social problems, and discussed other matters of interest to the engineers and technical people present.

President Dean Harvey commented on the widespread interest in the work of the Society and stressed the important part in the work which District Committees must assume. He also emphasized to those present the fact that A.S.T.M., concentrating its work in the field of materials—standardization of specifications and tests and promoting knowledge of properties through research—was constantly endeavoring to cooperate fully with other engineering and technical groups, and was in no sense competing with other activities. He mentioned the excellent district meetings which have been sponsored during the year by various groups, including recent ones on the Pacific Coast in San Francisco and Los Angeles.

Arrangements for the meeting and dinner were made by the Cleveland District Committee officers, Arthur J. Tuscany (Metal Lath Manufacturers Assn.), Chairman, and Ray T. Bayless (Assistant Secretary and Editor, American Society for Metals), Secretary.

A.S.T.M. Participates in Chicago War Production Conference

In line with the practice of the Society to contribute wherever possible to the war effort, it participated through its Chicago District Committee in the War Production Conference held at the Hotel Stevens, Chicago, on March 30, 1944. The conference consisted of some thirty panels covering a variety of subjects ranging from manufacturing processes, as, for example, discussion of machine shop and foundry practice, welding, etc., to discussions dealing with specific materials and on some such general topics as management. The Chicago District Committee acted as joint sponsor of two panels dealing with the use of plastics and a panel dealing with protective coatings and acted as sole sponsor for the session on standards and specifications. Panel sessions were held in the morning and afternoon, the morning panels being adjourned in time for a luncheon which was addressed by J. L. Collyer, President, The B. F. Goodrich Co., on the subject "America's Rubber Outlook."

The District Committee had gone to considerable pains in arranging for the Panel on Standards and Specifications, the subject being introduced by three speakers, namely, P. V. Faragher, Metallurgist, Aluminum Co. of America, who spoke on "Specifications and Inspection from the Manufacturing Viewpoint," L. J. Harris, Director, Signal Corps Inspection Agency, U. S. Army, who covered the subject of "Specifications and Inspection from the Signal Corps' Viewpoint," and J. R. Townsend, Materials Standards Engineer, Bell Telephone Labs., Inc., and Vice-President of the Society, who spoke on "Specifications and Inspection from the Commercial and Purchasing Viewpoint."

H. H. Morgan, Chief Engineer, Robert W. Hunt Co., and Past-President of the Society, acted as chairman of the meeting. He outlined the purpose of the panel, namely, to deal with material specifications and inspection from several points of view but confined to materials for use in fabrication of devices and equipment. Excerpts from his remarks accompany this article.

The first speaker, Dr. Faragher, outlined the requirements of a good specification, namely, that it should be a description of the material that is desired setting forth whatever requirements are needed to secure that material, but not embellished with unnecessary requirements. At the same time, he recognized the difficulty of giving adequate description in every respect and the necessity for including some general requirements in order that the material would give satisfactory performance. The need for having complete and adequate specifications is particularly important in the case of Government purchases. Since such purchases of necessity need to be made under competitive bidding, it is all the more important that the material desired be adequately described. Particularly in view of the general requirements, inspectors should be well informed concerning the actual *performance* needs.

Colonel Harris outlined the various steps that had been taken to build up a competent inspection force and some of the difficulties which were met by the services in the inspection of materials.

Mr. Townsend described a number of tests that are applied to materials used by the Bell system in order to evaluate performance of the material. He also expressed

his view that increasing attention would need to be given to testing of composite materials since frequently it is no longer a question of testing single materials but of evaluating some composite. He ended by showing motion pictures that had been taken of various testing operations.

The arrangements for the several panels in which the Society was interested had been ably handled by the officers of the Chicago District Committee: E. R. Young, Chairman; J. de N. Macomb, Vice-Chairman, C. E. Ambelang, Secretary, and J. F. Calef, Chairman of the Program Committee.

Excerpts from Remarks of H. H. Morgan, Presiding at Chicago War Production Conference Panel on Materials Specifications and Inspection

With the unusual stresses of this war straining the material resources of this country, the material specifications of the Society have not only met the pressure of peace times but are meeting those of war times supplemented with such emergency provisions as the war makes advisable.

. . . by material specifications, we do not mean specifications for devices, equipment, or projects. We mean the materials that have a varied application in fabrication into devices, equipment, or into construction projects. Such specifications are used in securing material for use in the fabrication of all peace- and wartime devices and equipment.

. . . The selection of materials necessarily involves consideration of the use of the equipment and the engineering properties of the material involved. The material specifications must detail significant requirements or criterions of the material for the control of manufacture, and also to effect inspection necessary to secure a uniform product complying with the requirements that will result in equipment that performs with satisfaction the use to which it is put in service. The availability of the material is an added consideration, particularly in war times when substitute materials must be used in place of more critical material.

Control of manufacture and inspection must be made first by the manufacturer of the material and then inspection must be made by the user to ascertain or check that the materials furnished comply with the requirements. The extent to which any material should be subject to inspection depends largely on the importance in the equipment in which it is used, or the quantities in which it is used. Wherever its failure in service would mean costly delays in production or loss of life then the most constant and rigid inspection should be employed by the manufacturer and by the user. Wherever practical, such inspection should be made at point of manufacture by the user in order that the production of unsatisfactory material can be limited. Adequate specifications for materials with competent inspection by producer and user assure maximum usefulness and serviceability of the material and, in turn, the equipment from which such material results.

Now the part that material specifications and inspection play in war time is manifestly even more important than in peacetime, for in war time we deal with equipment whose use is severe and where failures occur the result is not only loss of life but serious miscarriage of our War Program toward victory.

. . . a necessary corollary to specifications is adequate inspection. It serves little purpose to have well-written specifications if they are not strictly observed and this will happen only if there is competent inspection. Specifications and inspection are complementary—one without the other is like a one-legged man. Together they form the bases for good work.

Philadelphia Meeting on "Engineering Abroad"

About 85 members and visitors heard two of the most interesting general discussions presented at any of the meetings sponsored by the Philadelphia District Committee during its current season at the meeting Thursday, April 20, at the Franklin Institute. The talks by *Engineering News-Record* Editor Waldo G. Bowman and Managing Editor Edward J. Cleary covered their visits to England, North Africa, Iran, and South America, particularly Brazil. Preceding the meeting there was an informal dinner with about 40 present. Frank G. Tatnall, Chairman of the District Committee, presided at the function.

Mr. Bowman in his illustrated talk stressed several matters. First, the feeling that with air transportation what it is, and a growing community of interest on many problems, we are going to have large groups of people who will certainly not favor any national policy of isolation. He emphasized the unique abilities of all engineers in the war zones of applying materials of all kinds and stressed the rapid erection techniques which were developed by the army engineers and others. Following discussions of construction of air fields in Britain, types of construction at camps, he discussed unique problems in North Africa and stressed the importance of the Iran theater of war and of the remarkable results in transporting by sea and rail huge quantities of materials to the Russians.

Mr. Cleary who had visited a number of South American countries, spending considerable time in Brazil, expressed his conviction that the expenditures we have been making in Latin America are not out of reason considering the immediate war problems involved and also the future industrial significance of the country. He referred to the progress Brazil is making in steel production, with, as its basis, the very large iron ore deposits near Volta Redonda, and other industrial developments including the mining of mica an important war material. Mr. Cleary discussed the Ford rubber plantations which are now turning out, after many years of development work, several hundred tons of crude rubber, with an anticipated rubber production within the next few years reaching 5000 tons annually. In addition to the industrial aspects, he stressed for this particular project the important social benefits to the laboring class. Also he referred to the high esteem accorded the technical and engineering profession in Latin America.

This meeting was the fifth sponsored during the season by the Philadelphia District Committee, completing one of its most successful years.

Chicago Group Discussion on Materials Specifications

At a meeting jointly arranged by the Chicago A.S.T.M. District Committee with the Chicago Section of the American Chemical Society following the meeting of the latter on March 23, there was a group discussion on the "Significance of A.S.T.M. Specifications" by J. J. Kanter, Materials Research Engineer, Crane Co. Mr. Kanter, who has been extremely active in A.S.T.M. work, stressed numerous reasons for standardized specifications, outlining their significance from the standpoint of simplification, economics, etc. There was discussion on the complexity of this work, but it was pointed out that even with the relatively large number of current specifications the situation is infinitely better than the tens of thousands of differing orders and requests that might result without the benefit of channeling-orders, etc., by means of standards. Relationship of A.S.T.M. specifications and those of other standardizing bodies, including the government, was discussed. Mr. Kanter outlined the various mechanics by which the A.S.T.M. attempted to keep its requirements in line with latest industrial practice and to give everyone concerned a voice in the preparation of the standards.

Vice-President Bates Speaks at California District Meetings

DURING HIS current visit to the Pacific Coast in connection with work at the National Bureau of Standards where he is Chief of the Clay and Silicate Products Division and also in charge of the Cement Reference Laboratory, P. H. Bates, Senior Vice-President of the Society, addressed two meetings of A.S.T.M. district members, one in Northern California (San Francisco), the other in Southern California (Los Angeles). The district committees in each locality, having been apprised of his visit, arranged to have him speak on subjects in which he is an outstanding authority—cement and concrete—which topics are of very intense interest in California because of their widespread use there in various structures. Following a few notes on his talks, there are given below for the respective districts additional information pertaining to each district meeting.

MR. BATES' ADDRESS

After an interesting and informative historical review of the development of cement specifications from the early cements to the present types of products, he presented the idea of a basic change in cement specifications to require limits of physical properties and heat of hydration rather than the present limits on compositions, bringing out various points which seemed to justify this concept. Other topics that were covered involved the effect of aggregates on soundness of concrete which is a matter of great interest to Western engineers, and he also discussed at some length the use of aerated cement to reduce spalling due to freezing and thawing. Some of the limitations of the use of this product in which there is much current interest were elaborated.

A vision of the future of concrete was seen in the hope of new specifications and building codes which will permit additions and changes in portland cement. He prophesied that if the manufacturer were given more freedom for individual accomplishment in developing cement to meet structural requirements, progress is certain. He directed attention to progress that is now being made in new architectural design involving concrete and he also presented a clear picture of the future of polychrome concretes.

Mr. Bates, who has been chairman of A.S.T.M. Committee C-1 on Cement for many years during which time the important changes involving the consolidation of the various specifications into the present C 150 with its different grades were made, described the characteristics of several types of cement and commented on their applications in different types of construction.

Editor's Note.—The above notes are a combination of information furnished by Professor Converse, California Institute of Technology, who was in charge of publicity for the Southern District, and by Theodore P. Dresser, Jr., Abbot A. Hanks, Inc., secretary of the Northern District.

Northern District Notes:

The meeting in San Francisco took the form of a joint dinner and technical session with the Structural Engineers Association of Northern California, and was held at the Engineers' Club on May 2. Chairman Dozier Finley, The Paraffine Cos., presided for the A.S.T.M. group, with C. E. Seage, President of Structural Engineers Association, as co-chairman. In addition to the feature address by Mr. Bates, there was a discussion by Commander C. L. Macrae on the history and origin of the Seabee branch of the Navy, followed by a motion picture "Seabees' Activities in the Field." There were about 100 in attendance at the dinner, and a larger group at the technical meeting which followed.

Southern District Notes:

The meeting in Los Angeles on May 8 was held in the Crystal Room of the Clark Hotel which was filled to capacity with technical men, cement company executives, and others concerned. W. C. Hanna, California Portland Cement Co., and chairman of the District Committee, introduced Vice-President Bates, and the discussion period was led by T. A. Fitch, Bureau of Standards of Los Angeles, past-chairman of the District Committee, and former officer of the Society. There was very interesting discussion with a large number of questions on which Mr. Bates commented.

Members of the District Committee were introduced by E. O. Slater, President and Manager, Smith-Emery Co., Vice-Chairman, while R. B. Stringfield, Consolidated Vultee Aircraft Corp., member of the committee, introduced other guests. The committees which took care of various activities for the meeting were as follows: Arrangements, R. G. Osborne, Raymond G. Osborne Testing Laboratories, and H. W. Jewell, Pacific Clay Products; Program and Invitation, R. E. Paine, Aluminum Co. of America (Committee Secretary), and E. O. Slater; Reception, F. J. Converse, and T. A. Fitch; A.S.T.M. Exhibit, T. A. Fitch and H. E. Jung, Southern California Edison Co.; Attendance, E. F. Green, Axelson Manufacturing Co., and R. H. Pierson, U. S. Naval Drydocks; Publicity, F. J. Converse.

NEED FOR COOPERATION[1]

The favorable changes in the supply requirements over the past few months of certain essential materials, notably metals and ferro-alloys, have resulted from cut-backs in military programs, past conservation measures, better control over distribution and use, completion of facilities, a more conservative inventory and purchasing policy by industry, and increased efficiency. Maintenance or improvement of these favorable positions from now on, depends largely on the progress of the war.

Meanwhile, industry can cooperate effectively by seeing that production plans for new or expanded uses of materials even though permitted by administrative controlling orders, are developed only when *all* of the three following conditions apply:

1. The proposed revision is essential and does not interfere in any way with the production of munition end products.
2. It does not substitute a critical material for a noncritical material.
3. The availability of the following associated resources are clearly established, without endangering current essential programs: Fuel, Power, Transportation, Facilities, Labor, Components, Other Materials involved.

In addition, it is desirable that any proposed change accomplish *one or more* of the following:

(*a*) It should use associated resources, particularly manpower, more efficiently;

(*b*) Or improve the product;

(*c*) Or keep a necessary facility in operation as a reserve to the war effort.

[1] From Issue No. 12. Material Substitutions and Supply List, April 15, W.P.B.

ASTM Bulletin

MAY 1944

NO. 128

TWO-SIXTY
SOUTH BROAD ST.
PHILADELPHIA, PENNA.

New Publications Issued

ANNOUNCEMENT HAS been made previously of several publications that are in preparation, and the following notes will give latest information on their respective progress.

Symposium on Identification of Water-Formed Deposits, Scales, etc.:

One of the two interesting technical symposiums included in the 1943 *Proceedings* which have been issued in reprint form is The Symposium on Identification of Water-Formed Deposits, Scales, etc., which includes an extensive introduction by H. C. Miller, with results of a series of round-robin tests aimed to provide comparative information on the use of macrochemical analysis, petrographic examination, and X-ray diffraction studies. Also there are three technical papers: X-ray Diffraction Methods in the Study of Power Plant Deposits (Imhoff and Burkardt); Diagnosis of Water Problems at Limbo Station (Partridge, Scott and Morrison); and Interpretation of Analyses and Problems Encountered in Water Deposits (Holmes and Walker); and a General Discussion. This 44-page reprint, in heavy paper cover, can be obtained by members at 50 cents per copy; nonmembers, 65 cents.

Symposium on Mildew Resistance:

Recently off press is the Symposium on Mildew Resistance comprising four technical papers and discussion presented at the meeting of Committee D-13 on Textile Materials in New York City last fall. This booklet will be of interest to wide segments of the textile industry and is particularly pertinent because of the necessity of producing materials that afford maximum resistance to mildew and rot occasioned by severe climatic conditions in various parts of the world. A list of the papers and their authors follows:

The Problem of Standardizing Test Method for Mildew and Rot Resistant Treatments of Textiles—H. D. Barker, G. A. Greathouse, and P. B. Marsh, United States Department of Agriculture

Evaluating Fabric Treatment for Mildew or Rot Resistance by Pure Culture Methods—G. A. Greathouse, P. B. Marsh, and H. D. Barker

Testing Mildew Resistance of Treated Fabrics by the Soil-Suspension Method—Margaret S. Furry, U. S. Department of Agriculture

Observations on Soil-Burial Procedures—Elmer C. Bertolet, Jeffersonville Quartermaster Depot

The seven pages of discussion enhance the value of the booklet suggesting other techniques and procedures that have been followed. Also the authors give some further comments on their papers.

Copies of this 40-page pamphlet in heavy paper cover can be obtained by members at the price of 50 cents; the price to nonmembers is 65 cents.

Symposium on Applications of Synthetic Rubbers:

This extensive symposium needs no further description because of the condensed abstracts of the papers published in the March BULLETIN and in view of the publicity given the Spring Meeting at which this symposium was the technical feature. Suffice it to say that it is considered

Come to the Annual Meeting!

I WISH TO URGE every member of the Society to attend our Forty-seventh Annual Meeting, June 26 to 30, inclusive, at The Waldorf-Astoria, New York City. The program, which is given on page 48 of this BULLETIN, has a wealth of material from which each of us will find subjects of interest. There is much of value on current problems in the materials field.

There are real benefits to be derived by attending the various sessions with technical papers, reports, and discussions, associating with authorities in the field of materials, and those of you who are committee members by attending your various meetings.

We also have an obligation to share with fellow engineers our ideas by taking part in the discussion of the various topics. One of the factors which makes our meetings so valuable to all those in the materials field is the willingness of our leading technical men to participate by taking part in the discussion of our technical papers and reports.

The 1944 meeting will bring out new data and information of much importance.

Again, let me urge you to spend a day, or more if possible, at this meeting.

Dean Harvey

President.

a very timely and helpful technical contribution, giving as it does latest information on general problems in connection with the evaluation and application of the principal types of synthetic rubbers; seven of the 13 extensive papers give pertinent discussion on specific fields where synthetic rubbers are applied—for example, hose and belting, hard rubber products, sponge rubber and the like. These papers are all in type and should be available for distribution in the early part of June. A prospectus order blank has been sent to members so that they can send in advance orders for copies at the special member's price of $1.00 in paper, $1.25 in cloth; nonmember's prices being $1.25 and $1.50, respectively, for this 150-page compilation.

Hardness Test of Metals:

This 64-page publication (a 1943 *Proceedings* reprint) will be of interest to all those concerned with hardness testing of metals. Following some notes on hardness by Prof. J. M. Lessells, there are conversion tables, a selected bibliography, followed by two extensive papers by S. R. Williams on "Present Types of Hardness Tests," and by S. L. Hoyt on "Fundamentals of Hardness Testing." In addition to these three contributors, a number of other authors in the field have participated, and the general discussion is of considerable interest.

The most extensive is by Dr. L. B. Tuckerman, National Bureau of Standards, an authority in this field, who adds much to the interest and value of this book by bringing in quite appropriately a discussion on problems in connection with grit in chickens' gizzards, describing a mechanical gizzard for testing hardness. Copies of this reprint are available to members at 50 cents per copy; to nonmembers at 75 cents.

FORTHCOMING PUBLICATIONS

In addition to the publications described above—either published or to be available shortly—two other outstanding technical compilations are in process, one, the extensive Symposium on Plastics which featured the 16 technical papers presented at a two-day symposium in Philadelphia; the other, a compilation of Proposed Methods of Evaluating Various Properties of Soils.

Symposium on Plastics:

The Symposium on Plastics, expected to aggregate about 200 pages, should be available soon after the Annual Meeting. It had been hoped to push the publication to completion earlier but delay in receipt of manuscripts of one or two of the technical papers, plus the heavy load of editing papers and reports for the Annual Meeting, will postpone completion of the publication until sometime in July.

Compilation of Soil Testing Methods:

At the 1943 Annual Meeting of the Society, there was an extensive discussion on soil test methods where groups of tests were presented in preparation for a more formal and extensive symposium at a later date. The editing of the various tests proposed by different individuals, laboratories, and departments has been practically completed looking toward the publication of this material to elicit criticism and comments. With these proposed methods will be included the 12 tests that have been accepted as standards or tentative standards by the Society. By this procedure, Committee D-18 on Soils for Engineering Purposes, which is sponsoring the publication, and the Society hope eventually to crystallize opinion so that there will be adequate tests agreed on for evaluating soils for various purposes.

Comprehensive Symposium on Stress Corrosion Cracking

Joint A.I.M.E.-A.S.T.M. Meeting—Benjamin Franklin Hotel, Philadelphia, November 29 and 30

A SYMPOSIUM on Stress Corrosion Cracking jointly sponsored by the American Institute of Mining and Metallurgical Engineers—Institute of Metals Division, and the American Society for Testing Materials will be held at the Benjamin Franklin Hotel in Philadelphia on Wednesday and Thursday, November 29 and 30. To date approximately 30 papers have been offered for presentation, with four or five technical sessions expected. These papers can be grouped in general into three categories—those covering brass, those covering the light metals, including aluminum and magnesium, and a miscellaneous group of papers. Since data on the phenomenon of stress corrosion cracking as related to other materials are available in a lesser degree, anyone who might contribute even isolated instances as papers or discussion of papers should communicate as promptly as possible with the Chairman of the Committee in charge, C. S. Cole, 5600 Broad Branch Road, N. W., Washington 15, D. C. Final date for receipt of manuscript of papers is August 15.

Sustaining Membership

THE JANUARY and March ASTM BULLETIN noted some 20 leading organizations concerned with the Society's work in materials who had subscribed to the class of Sustaining Membership. Recently four other organizations who have been affiliated with the Society for a number of years through various memberships have joined this group who through annual dues of $100 contribute to the support of the Society. The total number of Sustaining Members to date is 187. The four new ones are:

International Business Machines Corp., Endicott, N. Y.
National Electric Products Corp., Ambridge, Pa.
Permanente Cement Co., Permanente, Calif.
Sharples Chemicals, Inc., Wyandotte, Mich.

By action of the Executive Committee at the January meeting, Sustaining Members of the Society are being tendered a specially engrossed Sustaining Membership certificate, these being signed by the President of the Society at the time the membership became effective, and the Secretary-Treasurer.

For News of The Annual Meeting, see page 5;

for The Provisional Program, turn the page.

This Program Is Subject to Change

Provisional Program

FORTY-SEVENTH ANNUAL MEETING

of the

AMERICAN SOCIETY FOR TESTING MATERIALS

NEW YORK, N. Y. **WALDORF-ASTORIA** **JUNE 26 TO 30, 1944**

	Morning	*Afternoon*	*Evening*
Monday, June 26	Registration Committee Meetings	Committee Meetings	Committee Meetings
Tuesday, June 27	Committee Meetings	*1st* Water *2nd* Fatigue, Methods of Testing *3rd* Timber, Plastics, Electrical Insulating Materials, Rubber	Committee Meetings
Wednesday, June 28	*4th* Round-Table Discussion on Centrifugal Castings *5th* Petroleum Products, Coal and Coke, Fuels, Bituminous Materials, Soils *6th* Symposium on Analytical Colorimetry and Photometry	*7th* Symposium on Analytical Colorimetry and Photometry (*Cont.*) *8th* Paint, Paper, Soaps, Textiles *9th* 4.30 p.m., Marburg Lecture	*10th* General Session—Address by President Dean Harvey; Address by Charles K. Leith on "Minerals in War and Peace"
Thursday, June 29	*11th* Steel and Alloy Steel, Corrosion of Iron and Steel *12th* Cementitious and Masonry Materials	*13th* Non-Ferrous Metals and Alloys, Corrosion, Powder Metals *14th* Concrete	Committee Meetings
Friday, June 30	*15th* Concrete (*Cont.*) *16th* Non-Ferrous Metals and Alloys (*Cont.*)		

Tuesday, June 27 **2 p.m.** **First Session**

Held Simultaneously with the Second and Third Sessions

Water

Report of Committee D-19 on Water for Industrial Uses. Max Hecht, Chairman.

This progress report reviews briefly the activities of the committee during the year, including its sponsorship of the Round-Table Discussion on Organizing the Classification of Industrial Waters being held at this Annual Meeting.

Report of Joint Research Committee on Boiler Feedwater Studies. C. H. Fellows, Chairman.

Round-Table Discussion on Organizing the Classification of Industrial Waters

Through the work of Committee D-19 on Water for Industrial Uses, there have been developed practical, accurate, and standardized procedures for sampling and determining essentially all the significant constituents in waters. This has been coupled with a carefully thought-out method of reporting results which indicates exactly what is in the sample, without ambiguity, and without arbitrary systems of calculations which end up in writing down compounds which cannot possibly be present.

The chief and remaining problem is what do the results of the analysis mean?

What can be done to make the analysis of a water sample an understandable and useful tool, even for those individuals who are are not specialists in this field? In essence the problem resolves to a systematic, succinct and understandable presentation of the the relationship of a water analysis to its actual effecti n an industrial process. The first attack on this problem is being initiated with the papers and discussion in this symposium.

The plan for classification which looks most promising, which retains the necessary flexibility, and yet which gives even the layman a basis on which to judge his particular water sample from its analysis, is to describe the effect in various industrial processes of individual water samples selected as standards. The analysis of the unknown sample can be compared with the analyses of these standards and the description of the way these standard waters act in a definite application. Conclusions can then be reached as to how the unknown sample will act in a similar use.

Thus far, nine waters, representative of those that may be used industrially throughout the United States have been selected for standards. Complete analyses are available for these waters.

Introduction. W. C. Schroeder, U. S. Bureau of Mines.

This paper discusses the need for a method of classification for industrial waters which will help the engineer to understand a water analysis and will help the specialist in water treatment to record and correlate his own experience. Development of a satisfactory method of classification offers a tool for expressing the real meaning of a water analysis in language understandable to layman and specialist alike.

The paper traces the activities of Committee D-19 on Water for Industrial Uses which has led to this work on classification. It describes the various methods of classification that might be used and points out that any system with arbitrary and fixed lines of demarcation would probably fail when applied over the wide range of conditions encountered in industrial processes.

Typical Water Analyses for Classification with Reference to Industrial Use. W. D. Collins, U. S. Geological Survey.

A Geological Survey table of five typical analyses of surface and ground waters has been enlarged by the addition of three more analyses of fresh waters and an analysis of sea water. The nine analyses cover the range of composition of most of the waters used for different purposes by industrial plants. Some figures are given to indicate the relative extent of use of the different types. The geographic distribution of waters of the different types is indicated roughly.

The Use of Selected Waters in Pulp and Paper Manufacture. Lewis B. Miller, W. H. & L. D. Betz.

A series of waters of markedly different analyses and representing waters from different parts of the United States have been selected for discussion by the committee. The use of these waters in the manufacture of pulp and paper, and particularly in the manufacture of high-quality papers, is considered. Those characteristics which are particularly undesirable in water for fine paper manufacture are emphasized.

Treatment of Various Types of Waters for Operating Pressures Above 400 psi. R. E. Hall, Hall Laboratories, Inc.

In consummating the treatment of water for use in generating steam, we must provide for two drastically different sets of conditions as follows:

1. Those characterizing the dilute over-all boiler water, whose concentration of dissolved and suspended components is controlled as desired by blowdown;
2. Those obtaining as the over-all boiler water concentrates at steam-water interfaces, the concentration attained being a function of temperature at the interface, boiler pressure, and composition of the water in question.

Of particular influence in relation to (1) are such factors as uniformity of load and rating of the boiler, uses of the steam and elimination therefrom of CO_2 and NH_3, concentration and composition of dissolved and suspended solids in the boiler water, and the amount of blowdown necessary to limit them as required. In relation to (2), consideration must be given to boiler characteristics, such as pressure and rating, uniformity of circulation, type of boiler furnace, rate of heat absorption therefrom, and to the character of magma resulting from extensive concentration of the boiler water at steam-water interfaces. In this discussion, particular attention is given (2), because of its increasing significance with increasing operating pressure.

Boiler Feedwater for Between 100–400 psi. Boiler Pressure. J. A. Holmes, National Aluminate Corp.

Nine typical analyses of surface and ground waters as presented by the A.S.T.M. Committee on Classification of Waters are discussed in regard to their effect on scale formation, carry-over, and corrosion when used as boiler feedwater. The possibility of altering the characteristics of these waters by pretreatment to lower the total solids and scale-forming substances is shown.

Tuesday, June 27 2 p.m. Second Session

Held Simultaneously with First and Third Sessions

Fatigue, Methods of Testing

Report of Research Committee on Fatigue of Metals. H. F. Moore, Chairman.

The committee has been continuing the study of effect of size of specimens on fatigue of metals and a third progress report on this investigation is appended.

Report of Committee E-1 on Methods of Testing. W. H. Fulweiler, Chairman.

This progress report discusses the activities of the technical committees on mechanical testing, consistency and plasticity, statistical analysis, conditioning and weathering, laboratory apparatus, and hydrogen ion concentrations. It reports the completion of six new specifications for solvent distillation thermometers.

Characteristics of the Tuckerman Strain Gage. Bruce L. Wilson, National Bureau of Standards.

Following a brief description of an interferometric calibration device used at the National Bureau of Standards for calibrating Tuckerman strain gages, experimental results are given which indicate the variations of the calibration factor with different conditions of use. The results indicate that (1) the change in autocollimator reading is accurately proportional to the change in gage length of the gage, (2) the calibration factor is practically independent of the temperature within the range 70 F. to 100 F., (3) the calibration factor is independent of the position of the gage, and (4) the calibration factor is not greatly influenced by the material of the specimen provided the gage is properly attached.

Factors Affecting Hardness Relationships in the Range 50 to 250 Brinell. Robert H. Heyer, The American Rolling Mill Co.

This paper is a continuation of the work reported in a paper by the author on hardness conversions published in the 1942 A.S.T.M. *Proceedings* and was undertaken to assist the Subcommittee on Hardness Conversions of the E-1 Section on Hardness Testing in its study of hardness conversions for metals below about 250 Brinell (0 to 100 Rockwell B).

Data are presented to show the effect of rate of work hardening and the importance of close control of time of load application. A testing procedure is suggested for establishing both hardness and tensile conversion tables for specific materials. Another method based on contour of impressions is described for constructing general hardness conversion tables of improved accuracy.

Report of Commitee E-7 on Radiographic Testing. H. H. Lester, Chairman.

A progress report reviewing briefly the activities of the committee during the year.

Report of Committee E-8 on Nomenclature and Definitions. Cloyd M. Chapman, Chairman.

This progress report discusses briefly reviews made during the year of definitions prepared by other committees of the Society.

Report of Committee E-3 on Chemical Analysis of Metals. G. E. F. Lundell, Chairman.

A progress report reviewing briefly the activities of the committee during the year.

Report of Committee E-2 on Spectrographic Analysis. H. V. Churchill, Chairman.

This progress report reviews briefly the activities of the committee during the year.

Quantitative Spectrographic Analysis of Copper Alloys. R. A. Wolfe and Emile J. Jemal, University of Michigan and Federal-Mogul Corp., respectively.

A method is given for the routine spectrographic analysis of copper alloys. A large part of the elements determined are at the 10 per cent level but an occasional analysis is made as high as 25 per cent. Spectrographic sources are discussed and a new type spark source suggested. Various details of the problem such as errors due to sampling and corrections on the analyses due to interfering substances are considered. Sample working curves are included. It has been shown that during actual routine plant control errors of analysis should not exceed ± 1.5 per cent of the amount of the element present.

Tuesday, June 27 2 p.m. Third Session

Held Simultaneously with the First and Second Sessions

Timber, Plastics, Electrical Insulating Materials, Rubber

Report of Committee C-5 on Fire Tests on Materials and Construction. R. P. Miller, Chairman.

The tentative method of test for fire-retardant properties of wood is recommended for adoption as standard as revised, and an alternate test is presented for publication as tentative.

Report of Committee D-7 on Timber. Hermann von Schrenk, Chairman.

This progress report reviews briefly the activities of the committee during the year. Proposed methods of testing plywood and wood-base laminates are published as information with the report.

Fatigue Tests on Compressed and Impregnated Laminated Wood. Albert G. H. Dietz and Henry Grinsfelder, Massachusetts Institute of Technology and The Resinous Products & Chemical Co., respectively.

Wood veneers combined with phenolic resin are bonded at sufficiently high temperatures to set the resin and are simultaneously compressed to a fraction of their former thickness to yield high-density, high-strength material. Similarly, veneers impregnated with phenolic resin are compressed at high temperatures and pressures into strong, dense materials. In some instances the material is cross-banded, in others it is laminated. The resulting board is used for aircraft propellers and other purposes in which it is subjected to vibrating loads and stresses. In this paper are presented the results of a series of tests undertaken to determine the endurance characteristics and fatigue limits of a number of representative materials of the type described. The material, specimens, test methods, and results are set forth.

Report of Committee D-10 on Shipping Containers. Edward Dahill, Chairman.

This progress report reviews briefly the work before this committee.

Report of Committee D-20 on Plastics. Robert Burns, Chairman.

Specifications for cellulose acetate plastic sheets and for ethyl cellulose and methyl methacrylate molding compounds as well as methods for flexural testing, indentation hardness, specific gravity, luminous reflectance and transmission characteristics and color of plastics, stability of chlorine-containing plastics, and recommended practices for determination of the permanent effect of heat on plastics, accelerated weathering of plastics, and molding impact specimens of general purpose phenolic materials are recommended for publication as tentative. Reference is made to a number of specifications and methods of test for various types of plastics prepared by the committee during the year which have been accepted by Committee E-10 on Standards for publication as tentative. Revisions are recommended in ten of the tentative specifications and methods of test for plastics. A tentative revision of one of the standard methods, and adoption as standard of seven of the tentative methods of test is also recommended.

Static and Creep Properties of Mitscherlich Paper Laminated Plastic. W. N. Findley and W. J. Worley, University of Illinois.

Short-time tests of a Mitscherlich paper laminate in tension, compression, and torsion show the strength and stiffness of this material under static loads. All static tests were conducted at the same rate of tensile strain, and at a constant temperature of 77 F. and relative humidity of 50 per cent.

Results of long-time tension creep tests of specimens at eight different values of stress are reported. Creep was recorded over a period of 6000 hrs. at the same constant temperature and humidity used for the short-time tests. The creep tests are analyzed to show the effect of stress on the rate of creep. Creep properties of this laminate are also compared with creep properties of other plastics.

Indentation Hardness of Plastics. Ladislav Boor, American Cyanamid Co.

A study was made of the indentation behavior of typical soft metals and plastics on the Rockwell hardness tester. The proportion of the indentation which is recovered on removal of the major load is enormously greater for plastics, and hence measurements based on the depth after recovery are not a true measure of resistance to indentation.

A procedure was developed which permits measurement of indentation depth under major load. These values of indentation for various loads were then related by means of the Meyer equations, and a method of analyzing the curves was suggested.

Two new scales of Rockwell indentation hardness are proposed to cover the plastics now on the market, which extend the useful range of the instrument into the softer class of plastics. The degree of reproducibility of values among six different machines is shown. Data are presented showing the effect of thickness and layering of samples on indentation hardness.

Impact Testing of Plastics—II. Factors Which Influence the Energy Absorbed in Fracturing a Specimen. David Telfair and H. K. Nason, Monsanto Chemical Co.

The energy required to fracture a specimen is discussed from the standpoint of its dependence on the following four factors:

1. dimensions of the test specimen,
2. the notch,
3. rate of stressing, and
4. temperature.

Some of the similarities and some of the differences in the behavior of plastics on the one hand, and of metals on the other, are brought out. As with metals, it appears that the state of stress (as influenced by the notch) plays a more dominate role in determining the behavior of plastics than does the speed of testing or the temperature.

Flow Properties of Thermosetting Plastic Materials at Elevated Temperatures. John Delmonte, Plastics Industries Technical Institute.

Within the past year there has been considerable development and production of formed thermosetting laminates, particularly in the aircraft field. This paper proposes a technique for evaluating the comparative formability of various thermosetting laminates at high temperatures. The technique employed is a modification of the A.S.T.M. heat distortion point test. A constant high temperature is applied to a test specimen, supported on a 4-in. span, and the time-temperature characteristics are measured automatically at different stress values and at different temperatures. In addition the variables such as specimen size, and thickness, and the cure of the thermosetting laminates are evaluated.

Report of Committee D-9 on Electrical Insulating Materials. Myron Park Davis, Chairman.

New specifications for orange shellac and other Indian lacs for electrical insulation and methods of testing plastics for indentation hardness are recommended for publication as tentative. Revisions are recommended in the tentative specifications for phenolic laminated sheet for radio applications and in the tentative methods of testing untreated paper used in electrical insulation, conditioning plastics and electrical insulating materials for testing, and test for power factor and dielectric constant of electrical insulating materials. Eight of the tentative methods under the jurisdiction of the committee are recommended for adoption as standard as are the tentative revisions of the methods of testing electrical porcelain and shellac used for electrical insulation. New tentative revisions are recommended in five standard methods. A detailed summary of investigations of test procedures for dielectric strength of insulating fluids is appended.

Report of Sectional Committee C59 on Electrical Insulating Materials. H. L. Curtis, Chairman.

Reports on standards being recommended for submittal to the American Standards Association for approval as American Standard and on the new and revised methods which have been accorded such approval during the year.

Report of Committee D-11 on Rubber Products. S. Collier, Acting Chairman.

New specifications for cellular rubber products and methods of test for stiffening of vulcanized elastomers at low temperatures are recommended for publication as tentative. Revisions are recommended in the tentative specifications for chloroprene sheath compound for electrical insulated cords and cables where extreme abrasion resistance is and is not required and for insulated wire and cable, performance synthetic rubber compound, in the tentative methods of testing sponge rubber products, automotive hydraulic brake hose, automotive air brake and vacuum brake hose, and in the tests for changes in properties of rubber and rubber-like materials in liquids, for indentation of rubber by means of the durometer, and for low-temperature brittleness of rubber and rubber-like materials. It is recommended that the tests for resistance to light checking and cracking of rubber compounds and for tear resistance of vulcanized rubber be adopted as standard without revision.

Report of Committee C-14 on Glass and Glass Products. Louis Navias, Chairman.

A progress report reviewing briefly the activities of the committee during the year.

Wednesday, June 28 9.30 a.m. Fourth Session

Held Simultaneously with the Fifth and Sixth Sessions

Round-Table Discussion on Centrifugal Castings (with A.F.A.)

Several technologists representing leading producers and consumers will discuss problems in determining properties of the castings, types of specimens, and related matters. Production technique will be reviewed only to give a setting for the discussion.

Wednesday, June 28 9.30 a.m. Fifth Session

Held Simultaneously with the Fourth and Sixth Sessions

Petroleum Products, Coal and Coke, Fuels, Bituminous Materials, Soils

Report of Committee D-5 on Coal and Coke. A. C. Fieldner, Chairman.

Revisions in the standard method for designating the size of coal from its screen analysis are recommended for adoption as standard. It is recommended that the tentative revision of the standard methods of laboratory sampling and analysis of coal and coke be adopted as standard and that the tentative definitions of the terms gross calorific value and net calorific value of fuels be adopted as standard as revised. Editorial revisions are recommended in the tumbler test for coke and the methods of laboratory sampling and analysis of coal and coke.

Report of Committee D-3 on Gaseous Fuels. A. W. Gauger, Chairman.

A progress report reviewing briefly the activities of the committee during the year.

Report of Committee D-2 on Petroleum Products and Lubricants. T. A. Boyd, Chairman.

A revised method of test for potential gum in aviation gasoline is published as information with the report. Revisions are recommended in the following tentative methods: Tests for aniline point of petroleum products including a new procedure for mixed aniline point, consistency of lubricating greases and petrolatum, neutralization number (now designated acid number and base number) of petroleum products by color-indicator and electrometric titration, knock characteristics of aviation fuels, and for rust-preventing characteristics of steam-turbine oils in the presence of water. Revisions in the standard methods of test for gum content of gasoline and for sulfur in petroleum oils by the bomb method are recommended for immediate adoption. The tentative methods of test for saponification number of petroleum products by color-indicator titration and for knock characteristics of motor fuels are recommended for adoption as standard as revised and the tentative methods of test for oil content of paraffin wax, and method of conversion of kinematic viscosity to Saybolt Furol viscosity are recommended for adoption as standard without change.

Report of Sectional Committee Z11 on Petroleum Products and Lubricants. T. A. Boyd, Chairman.

A review is given of the new and revised methods accorded approval as American Standard during the year and to additional standards being recommended for submittal to the American Standards Association for approval as American Standard.

Report of Committee D-8 on Bituminous Waterproofing and Roofing Materials. J. M. Weiss, Chairman.

It is recommended that the tentative specifications for asphalt-saturated asbestos felts and asphalt-coated asbestos felts for use in waterproofing and in constructing built-up roofs and the tentative methods of testing felted and woven fabrics saturated with bituminous substances for use in waterproofing and roofing be revised. Revisions in the standard specifications for asphalt for use in constructing built-up roof coverings, for asphalt-saturated roofing felt and coal-tar saturated roofing felt for use in waterproofing and in constructing built-up roofs, and for woven cotton fabrics saturated with bituminous substances for use in waterproofing are recommended for immediate adoption.

Report of Committee D-4 on Road and Paving Materials. C. N. Forrest, Chairman.

A method of test for hot extraction of asphaltic materials and recovery of bitumen by the modified Abson procedure is recommended for publication as tentative. The present tentative revision of the standard method of test for ductility of bituminous materials is recommended for adoption as standard as are the tentative specifications for crushed stone, crushed slag, and gravel for water-bound macadam base and for crushed stone and crushed slag for bituminous macadam base and surface courses of pavements. The tentative volume correction table for tar and coal-tar pitch is recommended for adoption as standard.

Wednesday, June 28 9.30 a.m. Sixth Session

Held Simultaneously with the Fourth and Fifth Sessions

Symposium on Analytical Colorimetry and Photometry

Ever-increasing demands for speed and output of chemical determinations have forced the chemist to shorten methods of test to the absolute limit consistent with the accuracy that is needed. Important developments along this line have been the rapid improvement of apparatus for measuring the absorption of light by aqueous solutions, and of methods of test based on their use. The present symposium on analytical colorimetry and photometry has been planned to give a clear picture of what has taken place. To this end papers are presented on principles, apparatus, and applications. These include such topics as light, the derivation and use of laws, chemical principles, photoelectric cells, glass filters, filter photometers, spectrophotometers, errors involved in application of the instruments, the use of the methods in testing ferrous and non-ferrous metals, and bibliography.

I. Instrumental Section

Colorimetric Analysis and Beer's Law. J. L. Hague, National Bureau of Standards.

Photocells in Colorimetry. Ralph H. Muller, New York University.

Glass Photometric Filters. O. A. Gage, Corning Glass Works.

Filter Photometers. A. E. Ruehle, International Minerals and Chemical Corp.

Forms and Uses of Cells for Spectrophotometry. S. E. Q. Ashley, General Electric Co.

Greetings from the American Chemical Society. B. L. Clarke, Chairman, New York Section, A.C.S.

Trends in Analytical Chemistry. B. L. Clarke, Bell Telephone Laboratories, Inc.

Instrumental Errors. C. L. Luke, Bell Telephone Laboratories, Inc.

Wednesday, June 28 1.30 p.m. Seventh Session

Held Simultaneously with the Eighth Session

Symposium on Analytical Colorimetry and Photometry (Continued)

II. Chemical Section

The Physical Phenomena of Light and Color. R. J. Kryter, The Esterline-Angus Co., Inc.

The Chemistry in Colorimetry. M. G. Mellon, Purdue University.

Bibliography on Colorimetric Methods. J. W. Stillman, E. I. du Pont de Nemours & Co., Inc.

Specific Methods for Use in Aluminum Base Alloys. J. J. Stumm, William J. Jobbins, Inc.

Colorimetric Methods for the Analysis of Magnesium Base Alloys. V. A. Stenger, The Dow Chemical Co.

Absorptiometric Determination of Several Elements in Non-Ferrous Metals and Alloys. C. Zischkau, American Smelting and Refining Co.

Specific Methods for Use in Ferrous Alloys. Arba Thomas, The American Rolling Mill Co.

Wednesday, June 28 1.30 p.m. Eighth Session

Held Simultaneously with the Seventh Session

Paint, Paper, Soaps, Textiles

Report of Committee D-13 on Textile Materials. H. J. Ball, Chairman.

Revisions in the standard general methods of testing and tolerances for cotton yarns are recommended for immediate adoption. It is recommended that the present tentative revision of the standard methods of testing wool felt be adopted as standard and a further revision is presented for publication as tentative. The committee is also recommending for publication as tentative a revision of the standard methods of testing and tolerances for tire cord, woven and on cones, and for continuous filament rayon yarns. The tentative definitions and a number of the methods of test relating to textile materials are recommended for adoption as standard without revision.

Factors Influencing the Breaking Strength of Army and Navy Fabrics. Werner von Bergen, Forstmann Woolen Co.

In the specifications stipulated by the Army and Navy for woolen and worsted fabrics, breaking strength requirements occupy a prominent position, besides providing one of the most difficult problems for the manufacturer to solve. Many factors contribute in influencing the breaking strength, as evidenced by extensive studies conducted upon the following military fabrics: 18-oz. Serge for the Army and the 16-oz. Melton for the Navy.

These investigations show that a direct relationship exists between the variations in breaking strength of fabrics and that of the yarns from which the fabric is constructed. Moreover, they indicate that the most pertinent factors influencing yarn strength are yarn count, twist, wool blend, and dyeing method. Comparison is drawn between the effect of yarn count and twist upon the breaking strength of woolen and worsted yarns. The composition of wool blends likewise has proved to contribute to variations occurring in yarn strength, arising predominantly from differences in physical characteristics between various domestic and foreign wools. The influence of the various finishing operations is also discussed.

Report of Committee D-12 on Soaps and Other Detergents. H. P. Trevithick, Chairman.

New specifications for liquid toilet soap and the methods of chemical analysis of industrial metal cleaning compositions, which were published as information in 1942, as well as new and revised definitions of terms relating to soaps and other detergents are recommended for publication as tentative. The committee is also recommending that the tentative specifications for tetrasodium pyrophosphate be revised and continued as tentative and that the tentative specifications for powdered built soap, trisodium phosphate, compound chip soap, compound powdered soap, and methods of sampling and chemical analysis of soap, soap products, and special detergents be adopted as standard.

Report of Committee D-17 on Naval Stores. V. E. Grotlisch, Chairman.

Revisions are recommended in the tentative methods of sampling and grading rosin. Four proposed methods of test for determining unsaponifiable matter in rosin, definitions and tests applicable to tall oil, and tests for dipentene and for pine oil are published as information with the report. A paper by J. M. Wafer, A. Pollak, and R. Hastings on "Tall Oil for the War Effort" is appended.

Report of Committee D-6 on Paper and Paper Products. L. S. Reid, Chairman.

Eleven new proposed tentative methods are included, as follows: Tests for adhesiveness of gummed tape, bursting strength of paper, effect of heating on the folding endurance of paper, flammability of treated paper and paperboard, hydrogen ion concentration, penetration by water of sized paper and paper products, printing ink permeation of paper, water vapor permeability of paper and paperboard, and drop tests for shipping containers, puncture and stiffness testing of paperboard, corrugated and solid fiberboard, and testing containers in the small revolving hexagonal drum-box testing machine. The tentative methods of test for opacity and basis weight of paper and paper products, moisture in paper, paperboard, paperboard and fiberboard containers, conditioning paper and paper products for testing, quantitative determination of coating on mineral-coated paper, pentosans in paper, and internal tearing resistance of paper are recommended for adoption as standard without revision.

Report of Committee D-16 on Industrial Aromatic Hydrocarbons. J. M. Weiss, Temporary Chairman.

This report summarizes the organization of the committee and outlines the work that is contemplated for the subcommittees.

Report of Committee D-1 on Paint, Varnish, Lacquer, and Related Products. H. E. Smith, Chairman.

Eight new specifications for burnt and raw umber, burnt and raw sienna, venetian red, yellow iron oxide hydrated, black synthetic iron oxide, and isopropyl alcohol, and two new methods of test for water in lacquer solvents and diluents and test for daylight apparent reflection of paint finishes are recommended for publication as tentative. Revisions are recommended in the tentative definitions of terms relating to paint, varnish, lacquer, and related products and in the test for specular gloss of paint finishes. Ten of the tentative specifications and methods of test under the jurisdiction of the committee are recommended for adoption as standard, five with revision and five without change.

The Measurement of Fading Resistance of Camouflage Type Finishes by Accelerated Weathering. L. B. Darrall and J. W. Iliff, E. I. du Pont de Nemours & Co., Inc.

A study has been made to correlate the color change caused by normal accelerated weathering and by outdoor exposure of camouflage type paints meeting Army Engineer Specification T-1215 and revisions thereof. The color change was measured visually with a monostimulus reflectometer and the following conclusions were drawn:

(*a*) The correlation between accelerated weathering and outdoor exposure is not satisfactory due to deviations in direction as well as magnitude.

(*b*) As a research tool, however, the accelerated weathering device continues to be of interest.

The Interpretation of Visual Rusting Standards. W. F. Singleton, E. I. du Pont de Nemours & Co., Inc.

The usefulness of the photographic rusting standards can be extended by correlating the rust ratings in panel tests with practical service life of the paint system. For large uniform structural steel areas, a correlation may be established when one recognizes that the linear scale of the area under observation influences the severity of the rating. On structures which are built of rolled or fabricated steel shapes paint often fails in nonuniform patterns, such as flange or rivet rusting. Numerical ratings can be assigned certain types of failures by designating the repaint stage with a common numerical value.

Wednesday, June 28 4.30 p.m. Ninth Session

Marburg Lecture

The purpose of the Edgar Marburg Lecture is to have described at the annual meetings of the Society, by leaders in their respective fields, outstanding developments in the promotion of knowledge of engineering materials. Established as a means of emphasizing the importance of the function of the Society of promoting knowledge of materials, the Lecture honors and perpetuates the memory of Edgar Marburg, first Secretary of the Society who placed its work on a firm foundation and through his development of the technical programs brought wide recognition to the Society as a forum for the discussion of properties and tests of engineering materials.

Nineteenth Edgar Marburg Lecture: "Textile Fibers—An Engineering Approach to an Understanding of Their Properties and Utilization." By Harold DeWitt Smith, The A. M. Tenney Associates, Inc.

[*See news article on Lecture, p. 10*]

Wednesday, June 28 8.15 p.m. Tenth Session

General Session

Report of Committee E-10 on Standards. H. S. Vassar, Chairman.

The numerous new and revised tentative standards and tentative revisions of existing standards, as well as emergency standards and emergency alternate provisions accepted by Committee E-10 during the year are listed. Reference is made to the formation of three new committees in the Society to undertake standardization in the fields of light hydrocarbons, metal powders, and adhesives.

Report of Committee E-9 on Research. G. F. Jenks, Chairman.

Contains a brief discussion of research activities under way or sponsored by Society committees, and references to the work of the several research committees.

Annual Report of the Executive Committee. C. L. Warwick, Secretary-Treasurer.

A general report on Society activities and review of membership, publications, finances, and administrative matters relating to committee activities and inter-society relations.

Introduction of Newly Elected Officers.

The terms of the new officers, under the provisions of the By-Laws, begin at the close of the annual meeting.

Annual Presidential Address.

President Dean Harvey, Westinghouse Electric and Manufacturing Co.

Address by Charles K. Leith (WPB) on "Minerals in War and Peace."

[*see news article on this talk, p. 6*]

Award of Honorary Memberships.

Recognition of Forty-year Members.

Thursday, June 29 9.30 a.m. Eleventh Session

Held Simultaneously with the Twelfth Session

Steel and Alloy Steel, Corrosion of Iron and Steel

Report of Committee A-1 on Steel. N. L. Mochel, Chairman.

Many recommendations on revisions in specifications, adoption as standard of several tentative items are included together with discussion of several standardization projects under way in the subcommittees. The specifications in which revisions are proposed involve bars for springs, forgings, pipe and tubing, carbon and alloy steel plates for boilers, etc., sheets, and materials for high-temperature service. The report also discusses numerous emergency provisions developed during the year.

Report of Joint A.W.S.-A.S.T.M. Committee on Filler Metal. J. H. Deppeler, Chairman.

A brief progress report setting forth the activities of the committee during the year.

The Technical Cohesive Strength of Some Steels and Light Alloys at Low Temperatures. D. J. McAdam, Jr., R. W. Mebs, and G. W. Geil, National Bureau of Standards.

An investigation has been made of the technical cohesive strength of a high carbon steel, a stainless steel, duralumin, and magnesium alloys. Tension tests of notched and unnotched specimens have been made at room temperature and at selected low temperatures down to that of liquid air. Diagrams have been constructed to show the influence of notch depth, notch angle, and root radius on strength and ductility. A study is thus made of the influence of the ratio of radial to axial stress on the technical cohesion limit and the influence of plastic deformation, heat treatment, and temperature on technical cohesive strength.

Report of Committee A-5 on Corrosion of Iron and Steel. C. D. Hocker, Chairman.

It is recommended that the emergency specifications for lead coating (hot-dip) on iron or steel hardware be revised and published as tentative. Proposed specifications for lead-coated iron or steel sheets are published as information with the report. Also appended is a report on atmospheric corrosion tests of metallic coated hardware, structural shapes, and tubular goods begun in 1928 at five outdoor locations, containing a detailed tabulation of results of inspections after exposure.

Report of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys. Jerome Strauss, Chairman.

Revisions are recommended in the standard specifications for chromium and chromium-nickel plate and sheet for unfired pressure vessels and also in the specifications for chromium and nickel-chromium clad plate, developed in cooperation with the A.S.M.E. Boiler Code Committee. It is also proposed that the recommended practice for boiling nitric acid test for corrosion-resisting steels be revised. Excellent progress is reported on four specifications covering stainless tubing for various applications and new specifications for stainless spring and for hot-rolled and cold-drawn bars are in preparation. Included is a preliminary outline of the new program of atmospheric exposure tests, and a round-robin test on speed of testing.

Report of Joint Research Committee on Effect of Temperature on the Properties of Metals. N. L. Mochel, Chairman.

Report of Committee E-4 on Metallography. L. L. Wyman, Chairman

A résumé is given of the activities of the committee during the year.

Geiger Counter Spectrometer for X-ray Powder Diffraction. Herber Friedman, Naval Research Laboratory.

Report of Committee A-2 on Wrought Iron. C. B. Bryant, Chairman

A revision of the standard specifications for wrought iron plates is recommended for publication as tentative. The committee, acting jointly with Committee A-1 on Steel, is recommending that the standard specifications for riveted steel and wrought iron pipe be withdrawn.

Report of Committee A-3 on Cast Iron. J. W. Bolton, Chairman.

This progress report reviews briefly the activities of the committee during the year.

Report of Committee A-6 on Magnetic Properties. Thomas Spooner, Chairman.

A glossary of terms used in the testing of magnetic materials is recommended for publication as a tentative revision of the standard definitions of terms relating to magnetic testing. Revisions in the standard test for magnetic properties of iron and steel, including incorporation of the tentative tests for permeability and core loss of flat-rolled magnetic materials and for normal and incremental permeability and core loss of flat-rolled magnetic materials at low alternating inductions using 28-cm. specimen as well as the test for permeability of feebly magnetic materials, are recommended for adoption as standard. Appended is a report giving the results of the round-robin tests on which the procedure for core loss at 15 kilogausses was formulated.

Report of Committee A-7 on Malleable Iron Castings. E. K. Smith, Chairman.

A brief progress report reviewing the activities of the committee during the year and recommending revisions in the tentative specifications for pearlitic malleable iron castings.

Thursday, June 29 9.30 a.m. Twelfth Session

Held Simultaneously with the Eleventh Session

Cementitious and Masonry Materials

Report of Committee C-7 on Lime. W. C. Voss, Chairman.

It is recommended that the tentative revision of the standard methods of chemical analysis of limestone, quicklime, and hydrated lime be revised. Work is under way on tests on the extrusion machine, the autoclave, and workability and sand-carrying capacity of masonry mortars. Consideration is being given to master specifications for quicklimes and hydrated limes for the chemical industry.

Report of Committee C-1 on Cement. P. H. Bates, Chairman.

Presents tests for determining vinsol resin in cement, air content of portland-cement mortar, and heat of hydration of portland cement for publication as tentative. Methods of sampling, tests for fineness on the No. 200 sieve, time of set, specific gravity, and a pat test for soundness of hydraulic cement as well as tests for normal consistency and tensile strength of portland cement and portland cement mortars are recommended for immediate adoption as standard, to replace the standard methods of sampling and physical testing of portland cement. Revisions are recommended in the tentative specifications for air entraining portland cement for concrete pavements, and revisions in the standard specifications and methods of chemical analysis of portland cement are presented for immediate adoption. The committee is also recommending that the test for compressive strength of portland-cement mortars and portions of the tentative methods of chemical analysis of portland cement be adopted a standard. A report on cooperative studies of Darex as an air-entraining agent in portland-cement mortar is appended.

The Effects of Certain Variations in Consistency and Curing Conditions on the Compressive Strengths of Cement-Lime Mortars. G. J. Fink, National Bureau of Standards.

Data presented show that the compressive strengths of cement-lime mortars made with standard sand are higher when the consistency is adjusted to a flow of 75 per cent than when the flow is 110 per cent, the differences increasing with increasing cement content of the mortar.

Results of compression tests of masonry sand mortars show that the strengths of the high cement mortars (1:$^1/_4$:3 by volume) cured for 28 days in the damp closet are practically the same as when cured 7 days in the damp closet and 21 days in water, but that in the case of the higher lime mortars the damp closet cured specimens have appreciably higher strengths. Curing for 7 days in the damp closet, 18 days in water, and 3 days in laboratory air developed much higher strengths in all the mortars than did the other two cures.

Five masons limes of different types were included in the tests.

The Reaction of Vinsol Resin as It Affects the Air Entrainment of Portland-Cement Concrete. Charles E. Wuerpel and Albert Weiner, Corps of Engineers, U. S. Army.

Evidence from field construction indicated that the air content of concrete made with portland cement containing Vinsol resin was not closely predictable from the amount of Vinsol resin present in the cement as specified in A.S.T.M. Tentative Specifications for Treated Portland Cement for Concrete Pavements (C 175 – 42 T). In order to determine means by which the air entrainment could be made regulable to a reasonable degree, it was necessary first to learn the nature of the reaction between Vinsol resin and portland cement. It is the results of this investigation which are presented in this paper.

The initial investigation included tests on 106 commercially produced cements containing the normal flake Vinsol resin interground at the mill. The samples of these cements were taken from supplies used in field construction by the Corps of Engineers, U. S. Army. The data obtained led to a subsequent investigation, the results of which are included in an appendix to the current annual report of Committee C-1 on Cement. It was largely on the basis of these investigations that the currently recommended revisions of A.S.T.M. specification C 175 were submitted to the Society.

Comparative Tests of 52 Brands of Portland Cement from 15 Countries. E. V. Barrett, Minister of Public Works, Testing Materials Laboratory, Venezuela.

Report of Committee C-4 on Clay Pipe. Anson Marston, Chairman.

Presents proposed tentative specifications for extra-strength clay pipe and a new tentative revision of the standard specifications for clay pipe is also recommended.

Report of Committee C-6 on Drain Tile. Anson Marston, Chairman.

This progress report reviews briefly the activities of the committee during the year.

Report of Committee C-12 on Mortars for Unit Masonry. J. W. McBurney, Chairman.

The tentative specifications for aggregate for masonry mortar are recommended for adoption as standard and it is recommended that the tentative specifications for mortar for reinforced brick masonry be revised.

Report of Committee C-15 on Manufactured Masonry Units. D. E. Parsons, Chairman.

Revisions are recommended in the tentative specifications for glazed building units. The tentative specifications for building brick and test for initial rate of absorption and efflorescence of brick are recommended for adoption as standard, as is the tentative revision of the standard specifications for hollow load-bearing concrete masonry units.

Report of Committee C-16 on Thermal Insulating Materials. T. E. Cope, Chairman.

It is recommended that the tentative methods of sampling and mixing thermal insulating cement and the tentative definitions of terms relating to thermal insulating materials be revised and adopted as standard and that the tentative methods for bulk density of thermal insulating cement and for compressive strength and flexural strength of preformed block type thermal insulating materials be adopted as standard without revision. The committee is also recommending that the tentative test for covering capacity and volume change upon drying of thermal insulating cement be revised. Reference is made to proposed revisions in five of the emergency specifications under its jurisdiction.

Report of Committee C-8 on Refractories. J. D. Sullivan, Chairman.

The symbols for heat transmission appearing in the American Standard Letter Symbols for Heat and Thermodynamics Including Heat Flow (ASA Z10.4-1943) are recommended for publication as an A.S.T.M. tentative standard to replace Standard Symbols C 108. It is recommended that the tentative specifications for air-setting refractory mortars (wet type) for boiler and incinerator services be revised and revisions in the standard specifications for ground fire clay as a mortar for laying-up fireclay brick and method of test for pyrometric cone equivalent of refractory materials are recommended for publication as tentative.

Thursday, June 29 2 p.m. Thirteenth Session

Held Simultaneously with the Fourteenth Session

Non-Ferrous Metals and Alloys, Corrosion, Powder Metals

Report of Committee B-5 on Copper and Copper Alloys, Cast and Wrought. C. H. Greenall, Chairman.

The committee is recommending revisions in seven of its standard specifications for immediate adoption and that twenty-one of the tentative specifications under its jurisdiction be revised. These revisions involve withdrawal of sixteen of the B-5 emergency alternate provisions.

Evolution of Test Specimens for Non-Ferrous Castings. A. J. Smith, The Lunkenheimer Co.

In view of the wide current interest in the selection of suitable test specimens to properly meet specification requirements, a review has been made of the course of development of the present bars for bronze castings (A.S.T.M. specifications and Federal Specification QQ-M-151a). A discussion of test specimen requirements has also been made. Certain present specimens are shown to be inadequate on theoretical grounds and unjustifiable on historical grounds. Further study of test specimen designs is urged.

Report of Committee B-1 on Copper and Copper-Alloy Wires for Electrical Conductors. J. H. Foote, Chairman.

It is recommended that the emergency specifications for lead-coated and lead-alloy-coated copper wire for electrical purposes be revised and published as tentative and that the emergency alternate provisions applying to the standard specifications for concentric-lay-stranded copper conductors be incorporated in the standard. The committee has under consideration a new resistivity determination method and also has work under way looking toward a rationalization of area tolerances in the various stranded conductor specifications.

Report of Committee B-4 on Electrical-Heating, Electrical-Resistance, and Electric-Furnace Alloys. Dean Harvey, Chairman.

Specifications for chromium-nickel-iron alloy castings for high-temperature service and a test for equivalent yield stress of thermostat metals are recommended for publication as tentative. The committee also recommends tentative revisions of two standard specifications for drawn or rolled alloys for electrical heating elements.

Report of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. Sam Tour, Chairman.

The committee has under consideration revisions in the tentative method of salt spray testing of non-ferrous metals. A résumé is given of the activities of the various subcommittees, and a report on the results of tests on specimens cut from plates exposed to the atmosphere for ten years is appended.

An Alternate Immersion Test for Some Aluminum-Copper Alloys. R. B. Mears, C. J. Walton and G. G. Eldredge, Aluminum Company of America.

This paper describes an alternate immersion corrosion test which has been used for aluminum-copper alloys at the Aluminum Research Laboratories for the past eighteen years. Photographs and working drawings of the equipment are given, and the operation of the apparatus is described. Detailed test results on two widely used aluminum-copper alloys (17S-T and 24S-T) are given, and the sources of variation in test results are analyzed statistically. The effect of variation in test conditions, such as variation in solution concentration, period of exposure and thickness of the specimens, is discussed. Finally, the limitations and fields of usefulness of the test are detailed.

Basic Requirements in the Standardization of the Salt Spray Corrosion Test. Leo J. Waldron, National Bureau of Standards.

The salt spray test had become an important item within the past few years in the purchase of materials, principally with certain articles for use either on shipboard, at shore installations, or for storage under maritime exposures. The loss of materials and supplies under these conditions has been sufficiently great to warrant the incorporation of salt spray test requirements into many purchase specifications. Increased use of the test has made it advisable either to simplify existing and conflicting specifications or else to formulate a master specification which describes a standard method for conducting the test.

The basic requirements for operating and controlling the salt spray test are discussed in the light of recent experience with the method. Experimental data on the effect of some of the more important variables are given and discussed.

Report of Committee B-9 on Metal Powders and Metal Powder Products. W. A. Reich, Chairman.

This report summarizes the organization of the committee and outlines the work that is contemplated for the subcommittees.

Thursday, June 29 2 p.m. Fourteenth Session

Held Simultaneously with the Thirteenth Session

Concrete

Report of Committee C-9 on Concrete and Concrete Aggregates. F. H. Jackson, Chairman.

This report includes a number of new tentative methods which represent a revision of, and replace, the standard methods of test. These include tests for making and curing concrete compression and flexure specimens in the laboratory and in the field, test for compressive strength of molded concrete cylinders, and test for flexural strength of concrete. Revisions are recommended in the methods of securing, preparing, and testing specimens from hardened concrete, and tests for yield, weight per cubic foot, and air content of concrete. There is appended completely revised tentative methods for efficiency of materials for curing concrete and for surface moisture in fine aggregate.

Paper Appended:

Volumetric Methods for Determining the Air Content of Freshly Mixed Concrete. J. C. Pearson, Lehigh Portland Cement Co.

Sanford E. Thompson Award

To Douglas McHenry, Engineer, Bureau of Reclamation, U. S. Department of the Interior.

The Fourth Sanford E. Thompson Award will be made to Douglas McHenry, Engineer, Bureau of Reclamation, U. S. Department of the Interior, for his paper on "A New Aspect of Creep in Concrete and Its Application to Design," presented before the Society at the 1943 Annual Meeting. The Sanford E. Thompson Award was established in 1938 by Committee C-9 on Concrete and Concrete aggregates as an annual token of recognition to the author or authors of a paper of outstanding merit on concrete and concrete aggregates presented at an annual meeting of the Society. The award is named in honor of the first chairman of the committee.

A Comparison of Results of Sieving Procedures in Soundness Tests on Maine Sands. Andrew Adams and Horace A. Pratt, Maine State Highway Commission and University of Maine, respectively.

Recent magnesium sulfate soundness tests on Maine sands indicate that the inclusion of an alternate procedure in the A.S.T.M. Method C 88–41 T may be unnecessary. Results obtained at the Maine Technology Experiment Station by final sieving over the original sieves were equally as good as the results obtained using the half-size sieves.

Application of Fly Ash for Lean Concrete Mixes. Harry A. Frederick, Public Service Electric and Gas Co.

This paper demonstrates the application of fly ash when used as a partial substitute for cement and also for sand in lean concrete mixes (2 to 3 bags of cement per yard and W/C = 15 to 20 gal. per bag of cement). ion

Results of tests covering both methods of fly ash substitut are quite conclusive.

The data point out very clearly that no improvement in strength or workability is achieved by fly ash substitutions for cement in lean concrete mixes. Conversely, when fly ash (dry, wet, or at high carbon content) is substituted for sand, high early strength and improved workability result.

Entrained Air—Its Effect on the Constituents of Portland Cement Concretes. Henry L. Kennedy, Dewey and Almy Chemical Co.

Investigations covering the effect of two types of air entraining agents on the various constituents of portland cement concrete are reported. The amount of air entrained by the fine aggregate constituent of concrete varies greatly. A critical size range of aggregate is described, including a novel method of measuring the amount of air entrained in a wet mix. The effect of the air entraining agent on the portland cement constituent is also discussed. Ultropak microphotographs are shown for both cement and fine aggregate.

Concrete (and simulated concrete) with and without entrained air are described and illustrated to demonstrate the importance of controlled air content

Concrete Pavement Construction of Military Airfields. Burton J. Bell, U. S. War Dept., Atlanta.

The methods used by the War Department, Corps of Engineers in the construction of concrete pavement for airfields are discussed and illustrated. The paper includes a discussion of subgrade treatment, materials, proportioning and control of mixes, methods of testing beams and cylinders and curing. Brief job descriptions are included for about ten projects located in the southeastern states. Comparative results of test beams of pavements in which combinations of portland and slag cements, as well as treated cements, are shown. The paper reports some results of the extensive pavement evaluation studies now being made by the Engineer Department, and includes some data to show the influence of cement and aggregates on flexural strengths.

Friday, June 30 9.30 a.m. Fifteenth Session

Held Simultaneously with the Sixteenth Session

Concrete (Continued)

Precision Indices for Compression Tests of Concrete Cylinders Made from the Same Batch. S. P. Wing, W. H. Price, and C. T. Douglass, Bureau of Reclamation.

Data from representative concrete laboratories are utilized to establish indices indicative of the reproducibility of results in testing companion concrete cylinders. The indices sum up in a single figure the effectiveness of a laboratory's technique in uniformly molding, capping, curing, and breaking cylinders. Any laboratory by comparing its own results against those presented in the paper may judge the relative efficiency of its own technique. In another application the data are utilized to show that a 100 per cent humidity fog room does not cure cylinders uniformly and that substantial differences in strength exist dependent on location. The relationship of within-batch precision to batch-to-batch precision is discussed. The common practice of testing companion cylinders from the same batch is found to be wasteful duplication except under special conditions and a reexamination of such a requirement is indicated.

The Measurement of Concrete Strength by Embedded Pull-Out Bars. Bailey Tremper, Department of Highways, Washington.

The estimation of the strength of concrete in structures during the curing period by means of test cylinders is of doubtful accuracy because of differences in environment. Laboratory studies of a method of making a strength test of the concrete in place by means of embedded pull-out bars give promise of furnishing a better measure of actual compressive strength. It is believed that the test can be made on the job with relatively simple equipment.

Some Properties of Concrete Under Sustained Combined Stresses. C. M. Duke and H. E. Davis, University of California.

The paper describes some laboratory tests on concrete under various conditions of combined stress. The majority of the tests were made on cylindrical specimens under triaxial loading, using three ratios of axial to lateral load. A technique for conducting such triaxial load tests is described. The measurements include both lateral and axial deformations under sustained loading for the several combined stress conditions.

Also there are discussed the results of some sustained load tests on specimens in direct shear and torsional shear.

In addition there are included the results of a short supplementary series of tests to investigate the strength of concrete under triaxial loading.

Tests Comparing Dynamic (Sonic) and Compression Modulus of Elasticity, Modulus of Rupture and Compressive Strengths on a California Concrete Paving Project. T. E. Stanton, California Division of Highways.

This paper relates to tests designed primarily to compare the modulus of elasticity by the dynamic and compressive methods.

Dynamic modulus tests were made on both 6 by 6 by 34-in. beams and 6 by 12-in. cylinders; whereas, the compressive modulus of elasticity determinations were made on the cylinders only.

There was a close correlation at all ages (4 days to 1 yr.) between the dynamic modulus determinations on both beams and cylinders, but the compressive modulus of elasticity averaged considerably less than the dynamic.

The desirability of further studies is indicated to determine the relationship between the two methods.

The Effect of Cracks and Sections of Nonhomogeneous Materials on the Natural Frequency of Beams. Philip G. Kirmser, Kansas State College of Agriculture and Applied Science.

It has been found many times that the correlation between loss in modulus of rupture and loss in modulus of elasticity as determined by the sonic method is not very good.

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It is found that the effect of a crack on the natural frequency is surprisingly negligible, and that for a many-section beam satisfying certain conditions the frequency is the same as that of a beam of uniform cross-section whose properties are the average properties of the many-section beam.

The results can be applied to the interpretation of the behavior of concrete beams subjected to accelerated tests, and indicate that a loss in modulus of elasticity determined by means of vibrations always indicates a deterioration, but the type and extent of this deterioration are not certain.

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Held Simultaneously with the Fifteenth Session

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Presents the activities of the committee during the past year.

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The results of spreading tests of solders and fluxes were found useful for indicating optimum soldering temperatures and for rating fluxes.

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3-Methylpentane	205	[a]
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2,3-Dimethylbutane	207	0.06 ± 0.04
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Cyclohexane	209	0.012 ± 0.007
Benzene	210	0.05 ± 0.02
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This 282-page book, complete with detailed index, can be ordered from the A. F. A., 222 W. Adams St., Chicago 6, Ill., at $3.25 per copy.

Purchasing Agents Convention

AT ITS TWENTY-NINTH annual convention, May 29 to 31, incl., at The Waldorf in New York City, the National Association of Purchasing Agents has several interesting sessions planned with addresses by outstanding national figures, including Donald M. Nelson, Brigadier General Albert J. Browning, and others. These two men speak Monday morning, May 29, and in the afternoon there is a session with Messrs. J. F. Brownlee, OPA Deputy Administrator, with Walter C. Skuce, Director, Controlled Materials Division of WPB and Robert R. Wason, President, Manning, Maxwell & Moore, participating. That evening the U. S. Army Purchases Division will present its new pricing policies designed to replace current renegotiation. On May 30, materials problems are being covered with experts from Government agencies and from the N.A.P.A. ranks covering pulp and paper, rubber, fuels, and containers. The convention's final day involves reconversion and post-war problems. N.A.P.A. Headquarters are at 11 Park Place, New York City.

Calendar of Society Meetings

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American Society for Testing Materials—Forty-seventh Annual Meeting, June 26–30, Waldorf-Astoria, New York, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Summer Technical Meeting, June 26–30, New Jefferson Hotel, St. Louis, Mo.

AMERICAN PETROLEUM INSTITUTE—Annual Meeting, November, 13–16, Stevens Hotel, Chicago, Ill.

Entrained Air—Its Effect on the Constituents of Portland Cement Concretes. Henry L. Kennedy, Dewey and Almy Chemical Co.

Investigations covering the effect of two types of air entraining agents on the various constituents of portland cement concrete are reported. The amount of air entrained by the fine aggregate constituent of concrete varies greatly. A critical size range of aggregate is described, including a novel method of measuring the amount of air entrained in a wet mix. The effect of the air entraining agent on the portland cement constituent is also discussed. Ultropak microphotographs are shown for both cement and fine aggregate.

Concrete (and simulated concrete) with and without entrained air are described and illustrated to demonstrate the importance of controlled air content

Concrete Pavement Construction of Military Airfields. Burton J. Bell, U. S. War Dept., Atlanta.

The methods used by the War Department, Corps of Engineers in the construction of concrete pavement for airfields are discussed and illustrated. The paper includes a discussion of subgrade treatment, materials, proportioning and control of mixes, methods of testing beams and cylinders and curing. Brief job descriptions are included for about ten projects located in the southeastern states. Comparative results of test beams of pavements in which combinations of portland and slag cements, as well as treated cements, are shown. The paper reports some results of the extensive pavement evaluation studies now being made by the Engineer Department, and includes some data to show the influence of cement and aggregates on flexural strengths.

Friday, June 30 9.30 a.m. Fifteenth Session

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Concrete (Continued)

Precision Indices for Compression Tests of Concrete Cylinders Made from the Same Batch. S. P. Wing, W. H. Price, and C. T. Douglass, Bureau of Reclamation.

Data from representative concrete laboratories are utilized to establish indices indicative of the reproducibility of results in testing companion concrete cylinders. The indices sum up in a single figure the effectiveness of a laboratory's technique in uniformly molding, capping, curing, and breaking cylinders. Any laboratory by comparing its own results against those presented in the paper may judge the relative efficiency of its own technique. In another application the data are utilized to show that a 100 per cent humidity fog room does not cure cylinders uniformly and that substantial differences in strength exist dependent on location. The relationship of within-batch precision to batch-to-batch precision is discussed. The common practice of testing companion cylinders from the same batch is found to be wasteful duplication except under special conditions and a reexamination of such a requirement is indicated.

The Measurement of Concrete Strength by Embedded Pull-Out Bars. Bailey Tremper, Department of Highways, Washington.

The estimation of the strength of concrete in structures during the curing period by means of test cylinders is of doubtful accuracy because of differences in environment. Laboratory studies of a method of making a strength test of the concrete in place by means of embedded pull-out bars give promise of furnishing a better measure of actual compressive strength. It is believed that the test can be made on the job with relatively simple equipment.

Some Properties of Concrete Under Sustained Combined Stresses. C. M. Duke and H. E. Davis, University of California.

The paper describes some laboratory tests on concrete under various conditions of combined stress. The majority of the tests were made on cylindrical specimens under triaxial loading, using three ratios of axial to lateral load. A technique for conducting such triaxial load tests is described. The measurements include both lateral and axial deformations under sustained loading for the several combined stress conditions.

Also there are discussed the results of some sustained load tests on specimens in direct shear and torsional shear.

In addition there are included the results of a short supplementary series of tests to investigate the strength of concrete under triaxial loading.

Tests Comparing Dynamic (Sonic) and Compression Modulus of Elasticity, Modulus of Rupture and Compressive Strengths on a California Concrete Paving Project. T. E. Stanton, California Division of Highways.

This paper relates to tests designed primarily to compare the modulus of elasticity by the dynamic and compressive methods.

Dynamic modulus tests were made on both 6 by 6 by 34-in. beams and 6 by 12-in. cylinders; whereas, the compressive modulus of elasticity determinations were made on the cylinders only.

There was a close correlation at all ages (4 days to 1 yr.) between the dynamic modulus determinations on both beams and cylinders, but the compressive modulus of elasticity averaged considerably less than the dynamic.

The desirability of further studies is indicated to determine the relationship between the two methods.

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Sand Casting of Non-Ferrous Alloys

THIS HELPFUL publication compiled by certain divisions of the American Foundrymen's Association gives recommended practices for the sand casting of non-ferrous alloys. The committees that have developed the valuable information included in the book have followed a standard system in giving the recommendations. Following sections on definitions and fundamental metallurgy there is given advice on molding, melting and pouring, finishing, heat treatments, and causes and remedies of defects. Finally, properties and applications are covered. The book covers leaded red and yellow brasses; high-strength brasses; tin bronzes; nickel brass and bronzes; copper-silicon alloys; aluminum bronze; aluminum-base alloys; and magnesium-base alloys.

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EA – A 95

Issued April 26, 1944

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Standard Specifications for Carbon-Steel Castings for Valves, Flanges, and Fittings, for High-Temperature Service (A 95 – 41) and affect only the requirements referred to:

Section 5.—Change the carbon content from the present requirement "0.15 to 0.45" per cent to read "0.40" max. per cent.

Section 8 (a)—Change the table to read as follows:

Tensile strength, min., psi	65,000
Yield point, min., psi	35,000
Elongation in 2 in., min., per cent	20
Reduction of area, min., per cent	30

Section 10.—Change to read as follows:

When castings are purchased for use in accordance with American War Standard Pressure-Temperature Ratings for Steel Pipe Flanges, Flanged Fittings, and Valves, ASA B 16e5, each casting shall be tested after rough machining to the hydrostatic test pressure prescribed in the table below and shall show no leaks.

Primary Service Pressure Ratings, psi.	Standard Hydrostatic Test Pressure, psi.
150	350
300	900
400	1200
600	1800
900	2400
1500	4200
2500	7200

EA – A 157

(Standard Specifications for Alloy-Steel Castings for Valves, Flanges, and Fittings for Service at Temperatures from 750 to 1100 F.)

Issued, April 26, 1944

Section 10.—Change this section to read the same as Section 10 in Emergency Alternate Provision EA – A 95, above.

EA – A 216a

Issued, April 26, 1944

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Tentative Specifications for Carbon-Steel Castings Suitable for Fusion Welding for Service at Temperatures up to 850 F. (A 216 – 42 T) and affect only the requirements referred to:

Section 1 (b).—Add two new grades of carbon-steel castings designated Grade EWCC and Grade EWCD suitable for welding for applications as pressure containing turbine castings and a Grade EWCB to replace where acceptable Grade WCB for valves, flanges, and fittings.

Section 5.—Add to Paragraph (*a*) the following requirements as to chemical composition for Grades EWCC, EWCD, and EWCB:

	Grade EWCC	Grade EWCD	Grade EWCB
Carbon, max., per cent	0.30[a]	0.35[a]	0.30[a]
Manganese, max., per cent	0.60[a]	0.70[a]	0.70[a]
Phosphorus, max., per cent	0.05	0.05	0.05
Sulfur, max., per cent	0.06	0.06	0.06
Silicon, max., per cent	0.60	0.60	0.60

[a] For each reduction of 0.01 per cent below the specified maximum carbon content, an increase of 0.04 per cent manganese above the specified maximum will be permitted up to a maximum of 1.00 per cent.

Add in Paragraph (*b*) the symbols EWCC, EWCD, and EWCB to the heading of the table, since the requirements of this section apply to the three new grades.

Section 8 (a).—Add the following requirements for Grades EWCC, EWCD, and EWCB:

	Grade EWCC	Grade EWCD	Grade EWCB
Tensile strength, min., psi	60 000	65 000	65 000
Yield point, min., psi	30 000	35 000	35 000
Elongation in 2 in., min., per cent	24	20	20
Reduction of area, min., per cent	35	30	30

Section 10.—Change this section to read the same as Section 10 in Emergency Alternate Provision EA – A 95, above.

Section 16 (a).—Add the symbols EWCC, EWCD, and EWCB since the requirements of this section apply to the three new grades.

EA – D 231

Issued, April 13, 1944

The following Emergency Alternate Provision, when specified, may be used as an alternate in A.S.T.M. Standard Methods of Testing and Tolerances for Knit Goods (D 231 – 39) and affects only the requirements referred to:

Section 13 (a).—To provide for the use of an alternative extraction apparatus made of tinned copper and having a glass condenser as shown in the accompanying Fig. 1a, change the second sentence of this section to read as follows:

It shall then be extracted with carbon tetrachloride in either apparatus as shown in Fig. 1 or the accompanying Fig. 1a.

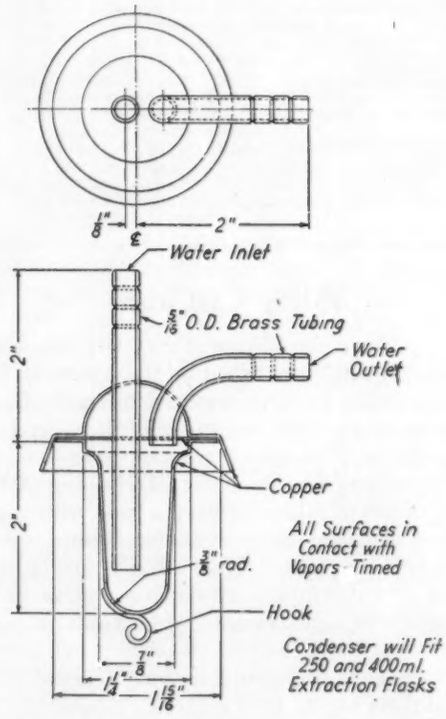

Fig. 1*a*.—Alternative Extraction Apparatus.

New Members to April 27, 1944

The following 80 members were elected from March 16 to April 27, 1944:

Chicago District

Armour and Co., V. Conquest, Director of Research, Chemical Research Dept., 1425 W. Forty-second St., Chicago 9, Ill.

Pickands Mather and Co., Edward C. Mathis, Metallurgist, 332 S. Michigan Ave., Chicago 4, Ill.

Seymour, David F., Chemical Engineer, Promat Division, Poor and Co., 851 S. Market St., Waukegan, Ill.

Walker, Alfred O., Chief Chemist, National Aluminate Corp., 6216 W. Sixty-sixth Pl., Chicago 38, Ill.

Cleveland District

Lester Engineering Co., Nathan Lester, President, 2711 Church Ave., Cleveland 13, Ohio.

Brueggeman, Elmer C., Chief Chemist, Seiberling Latex Products Co., Barberton, Ohio.

Gorrie, Harvard H., Design Engineer, Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Smith, H. H., Assistant Manager, Metallurgical Dept., American Steel and Wire Co., Rockefeller Bldg., Cleveland 13, Ohio.

Such, Irwin H., Engineering Editor, *Steel*, Penton Publishing Co., 1213 W. Third St., Cleveland 13, Ohio.

Swanker, Wilfred C., Chief Engineer, Acro Electric Co., 1305 Superior Ave., Cleveland, Ohio. For mail: 541 Cahoon Rd., Bay Village, Ohio.

Detroit District

Detroit Transmission Division, General Motors Corp., Frank Zuzich, Assistant Chief Metallurgist, 5140 Riopelle St., Detroit 11, Mich.

Libbey Glass, Division of Owens-Illinois Glass Co., H. R. Black, Chief Chemical Engineer, Box 919, Toledo 1, Ohio.

McCord Radiator and Manufacturing Co., Harry E. Moser, Chief Metallurgist, 2587 E. Grand Blvd., Detroit, Mich.

Babcock, Frederick A., President, Precise Instrument Co., 5034 Allendale Ave., Detroit 4, Mich.

Proulx, Bernard R., Michigan State College, Department Hotel Administration, East Lansing, Mich.

Nair, Frank B., Chief Engineer, Falls Spring and Wire Co., 949 Chicago Blvd., Detroit, Mich.

Underhill, Carl A., Sales Engineer, The American Metal Co., Ltd. of Michigan, Detroit, Mich. For mail: 1483 Cranbrook Rd., Birmingham, Mich.

Wagner, A. D., Chief Metallurgist, U. S. Naval Ordnance Plant, Westinghouse Electric and Manufacturing Co., 9 Mile and Mound Rd., Center Line, Mich.

New York District

Machlett Laboratories, Inc., W. E. Stevenson, Vice-President, 1063 Hope St., Springdale, Conn.

Mica Fabricators Assn., N. J. Bottie, Committee Chairman, 420 Lexington Ave., New York 17, N. Y.

Kerr, Frank M., Jr., Technical Director, American Oil and Supply Co., 238 Wilson Ave., Newark 5, N. J.

Sanborn, James F., Partner, Sanborn, Fitzpatrick & Murphy, 101 Park Ave., New York 17, N. Y.

Wilcox, Fred C., President, Commercial Concrete Equipment Co., 1 Wolf's Lane, Pelham 65, N. Y.

Williams, Frank S. G., Manager, Eastern Sales, Taylor Forge and Pipe Works, Room 2054, 50 Church St., New York 7, N. Y.

Northern California District

Foster, Bruce E., Associate Physicist, National Bureau of Standards, Permanente, Calif. For mail: 435 View St., Mountain View, Calif.

Lunt, Irving Robert, Jr., Chemist, Federated Metals Division of American Smelting and Refining Co., San Francisco, Calif. For mail: 81 Denslowe Dr., San Francisco, Calif.

Philadelphia District

Hamilton Laboratories, B. C. Ross, Technical Director, Hamilton Square, N. J.

Nicaro Nickel Co., F. F. Franklin, Plant Manager, Foot of Christiana Ave., Wilmington 83, Del.

Thermoid Company, Wayne Chatfield, Director of Testing Labs., Whitehead Rd., Trenton 6, N. J.

Williams, Brown & Earle, Inc., Peter Abrams, President, 918 Chestnut St., Philadelphia 7, Pa.

Backer, Stanley, Officer in Charge, Research Laboratory Section, Philadelphia Quartermaster Depot, 2800 S. Twentieth St., Philadelphia 45, Pa. [J]*

McCoy, W. J., Research Chemist, Lehigh Portland Cement Co., Young Bldg., Allentown, Pa.

Oehrle, Albert C., Superintendent, Oehrle Brothers Co., Inc., 423 N. Third St., Philadelphia 23, Pa.

Pfotzer, Edmond, Partner, E. & E. J. Pfotzer, 308 Marvin Rd., Elkins Park 17, Pa.

Porter, William H., Vice-President, T. J. Porter and Sons, Philadelphia, Pa. For mail: Box 28, Moylan, Pa.

Van Horn, William K., Test Engineer, Aircraft-Marine Products, Inc., 1523 N. Fourth St., Harrisburg, Pa.

Walsh, L. C., Chief Chemist, Walker Brothers, 331 W. Eleventh Ave., Conshohocken, Pa.

Pittsburgh District

Hamill, Hugh, Chief Chemist, Climax Molybdenum Co. of Pennsylvania, Langeloth, Pa.

Horvath, John J., Analytical Chemist, Pittsburgh Plate Glass Co., Creighton, Pa. For mail: 301 Charles Ave., New Kensington, Pa.

Lyon, P. W., Manager, Market Research, Wheeling Steel Corp., Wheeling, W. Va.

McNaugher, D. W., Jr., Vice-President and Assistant Treasurer, Robert W. Hunt Co., Professional Bldg., 429 Penn Ave., Pittsburgh 22, Pa.

St. Louis District

Hostetter, John C., President, Mississippi Glass Co., Main and Angelica Sts., St. Louis 7, Mo.

Southern California District

Harvill Corp., Max Powell, Chief Metallurgist, 6251 W. Century Blvd., Los Angeles 43, Calif.

Menasco Manufacturing Co., Lincoln Van Camp, Chief Metallurgist, 805 S. San Fernando Rd., Burbank, Calif.

Bonham, Loral D., Materials and Process Staff Engineer, Lockheed Aircraft Corp., Factory B, 1705 Victory Pl., Burbank, Calif.

Burkart, E. H., Group Engineer, Production-Research, Lockheed Aircraft Corp., Burbank, Calif.

Escobar, Miguel Walter, Chief Chemist, Federated Metals Division, American Smelting and Refining Co., Los Angeles, Calif. For mail: 222 N. Berendo St., Los Angeles 4, Calif.

Kennard, T. G., Chemist, 4686 Santa Fe Ave., Los Angeles 11, Calif.

Lieberman, Arthur Arnold, Chief Industrial Engineer, Petroleum Marketing Co., Los Angeles 11, Calif. For mail: 1480 Darlene Dr., La Habra Heights, Calif.

Mayo, Marion S., Textile Engineer, 122 E. Seventh St., Los Angeles 14, Calif.

Withrow, Arthur C., Owner, Arthur C. Withrow Co., 714 W. Olympic Blvd., Los Angeles 15, Calif.

Western New York-Ontario District

Greenfield Co., Inc., Samuel, Leonard Greenfield, Plant Manager, 31 Stone St., Buffalo 12, N. Y.

Schlegel Manufacturing Co., Emil J. Kayser, Chemical Engineer, 277 N. Goodman St., Rochester, N. Y.

Fabel, Clarence E., Curtiss-Wright Corp., Airplane Division, Buffalo 5, N. Y.

U. S. and Possessions

Other than A.S.T.M. Districts

Angier Products, Inc., Stanley O. Ames, Chief Chemist, 120 Potter St., Cambridge 42, Mass.

Asheville Mica Co., J. Fuller Brown, Vice-President, Biltmore, N. C.

Cardinal Corp., The, C. A. Bauer, Vice-President, Evansville, Ind.

North American Aviation, Inc., R. B. Jackman, Research Engineer, Plant B, Dallas, Tex.

Plastics Materials Manufacturers' Assn., F. H. Carman, General Manager, 631 Tower Bldg., Washington 5, D. C.

Union Bay State Chemical Co., Roland D. Earle, President, 50 Harvard St., Cambridge 42, Mass.

UNITED-CARR FASTENER CORP., R. O. Chaffee, Chief Engineer, 31 Ames St., Cambridge, Mass.

WHITIN MACHINE WORKS, Arthur A. Jackman, Metallurgist, Main St., Whitinsville, Mass.

AROSEMENA, JOQAUIN, Inter-American Trade Scholarship Trainee, Pittsburgh Testing Laboratory, 816 Howard Ave., New Orleans 13, La. [J]

BABB, ROBERT W., Engineer, Civil Aeronautics Administration, Box 3224, Seattle 14, Wash.

CANTRILL, CURTIS, Assistant Chief of Flexible Pavement Branch, U. S. Waterways Experiment Station, Box 631, Vicksburg, Miss.

DAWSON, JOHN W., Architect, Ellerbe and Co., E1021 First National Bank Bldg., St. Paul 1, Minn.

GONZALEZ, ORLANDO, Graduate Assistant, Department of Metallurgy, University of Notre Dame, 35 Engineering Bldg., Notre Dame, Ind. [J]

GROVE, JOHN M., Steel Testing Surveyor, Lloyd's Register of Shipping, 1221-23 Munsey Bldg., Baltimore 2, Md.

HENSON, GEORGE C., Vice-President and Technical Director, Industrial Products Manufacturing Co., 1208 Iron, N. Kansas City, Mo.

JACKSON, C. E., Chief Chemist, Paranite Wire and Cable Corp., First Ave., Jonesboro, Ind.

LONG, GEORGE R., Manager, Materials and Process Engineer, Frigidaire Division, General Motors Corp., Dayton 1, Ohio.

MINELLI, JOHN J., Consulting Chemist, 7 W. Market St., Wilkes-Barre, Pa.

OZELSEL, A. M., Research Assistant, University of Illinois, Urbana, Ill. For mail: 605 E. Daniel St., Champaign, Ill. [J]

PHILLIPS, HAROLD P., Hastings Manufacturing Co., Hastings, Mich.

SOBELL, O. H., Technical Director, The J. R. Watkins Co., Winona, Minn.

WETHERBEE, BURT, Manager, Technical Service, American Resinous Chemicals Corp., Peabody, Mass. For mail: 525 Washington Highway, Snyder 21, N. Y.

Other than U. S. and Its Possessions

HENLEY'S TELEGRAPH WORKS CO., LTD., W. T., W. C. Barry, Research Manager, Research Labs., Gravesend, Kent, England.

NEW ZEALAND PHYSICAL TESTING LABORATORY, The Director, 54 Molesworth St., Wellington, New Zealand.

ROBB, WILLIAM MUIR, Field Engineer, Ayeling-Barford, Ltd., Grantham, Lincs., England. For mail: Abbey House, 1 Castlegate, Grantham, Lincs., England.

TOPOUZADA, HUSSEIN TEWFIK, Sub-Director, Department of Industry, Ministry of Commerce and Industry, Cairo, Egypt.

* [J]—Denotes Junior Member.

Personals

• • • News items concerning the activities of our members will be welcomed for inclusion in this column.

PAUL FFIELD, formerly Materials Engineer of the Bethlehem Steel Co., Shipbuilding Division, Quincy, Mass., has relinquished his post to take charge as Superintendent of the newly formed Development and Research Branch of the Central Technical Department, Shipbuilding Division, at Quincy.

SAMUEL L. HOYT, Technical Advisor, Battelle Memorial Institute, Columbus, Ohio, was selected by the Golden Gate Chapter of the American Society for Metals to present its 1944 Educational Lectures. The lectures, on the subject, "Properties, Selection, and Specification of Alloys," were delivered at the University of California, Berkeley, on April 19, 20, 21, 24, and 25.

PAUL M. SNYDER, Metallurgical Engineer, Climax Molybdenum Co., Canton, Ohio, and also in charge of sales and development work in the Canton area since 1932, has been appointed Sales Manager of the company, with headquarters in Canton.

HERBERT J. FRENCH, Assistant Manager, Development and Research Division, The International Nickel Co., Inc., New York, N. Y., and formerly Chief of the Metallurgical and Conservation Branch of the Steel Division, War Production Board, has been named Assistant Director for Raw Materials and Facilities of the Steel Division, WPB.

L. E. DAY, formerly Chemist and Metallurgist, Development Department, Carrier Corp., Syracuse, N. Y., is now in the Design Engineering Division of the Westinghouse Electric Elevator Co., Jersey City, N. J.

DEAN D. CRANDELL, formerly Director of Research, National Gypsum Co., Buffalo, N. Y., was elected Vice-President in Charge of Research, it was announced at a recent meeting of the directors of the company in Buffalo, N. Y.

THOMAS H. WIGGIN, Consulting Engineer, New York, N. Y., was recently elected to honorary membership in the American Water Works Association.

ERNEST W. GASSAWAY, formerly located in Sacramento, Calif., is now in the Service, overseas.

On April 5 A.S.T.M. Committee C-14 on Glass and Glass Products held its annual meeting in Pittsburgh, new officers being elected as follows: *Chairman:* LOUIS NAVIAS, General Electric Co., Schenectady, N. Y.; *Vice-Chairman:* E. W. TILLOTSON, Assistant Director, Mellon Institute of Industrial Research, Pittsburgh, Pa.; *Secretary:* S. R. SCHOLES, Professor of Glass Technology, Alfred University, Alfred, N. Y.

G. F. JENKS, Colonel, U. S. Army, Retired, who has been connected for some time with the Taylor-Winfield Corp., Warren, Ohio, is now affiliated with North American Aviation, Inc., Inglewood, Calif. Colonel Jenks is residing in Los Angeles.

CLINTON E. TRIMBLE, who was Physicist, Materials and Processes Division, Consolidated Vultee Aircraft Corp., Vultee Field, Downey-Calif., is now Consulting Chemist and Physicist, and Member of Staff, Los Angeles City College, Los Angeles, Calif.

T. R. GALLOWAY has returned to Consolidated Edison Co. of New York, Inc., having served as Chief Engineer, Singmaster & Breyer, for some time. His office is at 4 Irving Place, New York, N. Y.

MYLES A. TIMLIN, formerly Testing Engineer, E. L. Conwell and Co., Baltimore, Md., is now connected with The Arundel Corp. in Baltimore.

A. F. GILL is now with Beardmore and Co., Ltd., Acton, Ont., Canada. He was connected with National Steel Car Corp., Ltd., Hamilton, Ont., Canada, as Assistant to the President.

J. C. ROBINSON, formerly Assistant Manager, The Mead Corp., Tannin Extract Division, Lynchburg, Va., is now connected with The Phosphate Mining Co., New York, N. Y.

E. O. REESE, who was Process Engineer, U. S. Rubber Co., Eau Claire Ordnance Plant, Eau Claire, Wis., is now with the Reese Manufacturing Co., Lancaster, Pa.

CECIL W. ARMSTRONG, formerly Senior Research Engineer of Lockheed Aircraft Corp., and Chief Engineer of Marco Chemicals, Inc., Sewaren, N. J., has been appointed Chief Development Engineer, Plastics Division, Continental Can Co., Inc., New York, N. Y.

ORA S. DUFFENDACK, since 1922 a member of the faculty of the University of Michigan, has resigned to accept a position with the North American Philips Co. of New York, N. Y., where he will organize a new research staff and laboratory. Mr. Duffendack has been a member of A.S.T.M. Committee E-2 on Spectrographic Analysis since its organization in 1932.

JAMES T. KEMP, formerly in the WPB Conservation Division, and later with the Conservation Branch, Army Service Forces, has been for some months stationed abroad as Conservation Representative of the U. S. Mission for Economic Affairs, with Headquarters at the U. S. Embassy.

T. A. HICKS, recently retired as General Chemist of the Universal Atlas Cement Co., New York, N. Y., who has been very active in the work of Committee C-1 on Cement since 1914, has been elected an Honorary Member of the committee, the first individual to be thus honored. In this way the committee not only gives signal recognition for his service to the industry and the committee, but also it will have the benefit of his counsel and participation in the technical activities.

R. S. ARCHER, formerly Chief Metallurgist, Chicago District, Republic Steel Corp., Cleveland, Ohio, is now associated with Climax Molybdenum Co., New York, N. Y., as Metallurgical Assistant to the

Vice-President. Mr. Archer is a member of A.S.T.M. Committee E-4 on Metallography.

THE ASPHALT INSTITUTE, originally organized as The Asphalt Association, is celebrating its Twenty-fifth Anniversary this year.

It has recently been announced that the national offices of the METAL LATH MANUFACTURERS ASSOCIATION, Cleveland, Ohio, have been moved to the Engineers Building, Cleveland. The new location will permit the association staff to enhance the services to architects, building commissions, contractors, in fact all having an interest in the building field.

THE PICKER X-RAY CORP. advises of the award by the War Department of their Second White Star for high achievement in production of Army Field X-ray Units. This organization was the first in the industry to receive the Army-Navy "E" Award in August, 1942; they obtained their First Star on July 10, 1943, and the Second White Star on February 26.

O. L. MOORE has retired from the Universal Atlas Cement Co., New York, N. Y., after thirty years of service. His position, Director of Tests and Research, is being filled by G. L. LINDSAY, who has been Assistant Director.

S. G. ESKIN, in addition to being Director of Research, Robertshaw Thermostat Co., Pittsburgh, Pa., has recently assumed the duties of Director of Research and Development, Grayson Heat Control, Ltd., a subsidiary of the Robertshaw Thermostat Co. He will be located in Los Angeles for an indefinite period.

F. H. FRANKLAND, for many years Director of Engineering, American Institute of Steel Construction, Inc., New York City, has resumed his former practice as consulting engineer, specializing in civil engineering. Before his formal contact with the Institute in 1928, he had been in consulting practice for many years and was a partner in the firm of Waddell and Son, later becoming connected with Dwight C. Robinson & Co. During his work at the Institute, he has acted as consultant and been connected with the design and construction of many outstanding bridge, building and related steel structures, both in this country and abroad. His offices are located at 271 Madison Ave., New York 16, N. Y.

H. P. BIGLER, who has been Assistant to the Vice-President, Connors Steel Co., Birmingham, Ala., and Consultant, Rail Steel Bar Association, has been elected Executive Vice-President, Connors Steel Co., according to an announcement received from President G. W. Connors, Jr. Mr. Bigler has for several years been secretary of Committee A-1 on Steel, and chairman of its Subcommittee V on Steel Reinforcement Bars.

THEODORE M. KUSS is now Vice-President, Frederic R. Harris, Inc., Consulting Engineers, New York, N. Y., and is in charge of West Coast office at 230 California St., San Francisco, Calif.

EDGAR K. MULL, formerly Chief Metallurgist, Bendix Radio Corp., Towson, Baltimore, Md., is now Chief Metallurgist, Barium Stainless Steel Corp., Canton, Ohio.

B. L. McCARTHY, for many years Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y., and chairman of the Western New York-Ontario A.S.T.M. District Committee, has been promoted to the position of Assistant General Superintendent where in addition to metallurgical and other technical problems he will be concerned with various duties embodied in the position. D. A. Sutch has been appointed Chief Metallurgist, reporting to Mr. McCarthy.

LLOYD M. MORRIS, who, as announced in the March BULLETIN, is associated with the War Department, is Officer in Charge, Engineering Division, U. S. Army, Jeffersonville Quartermaster Depot, Jeffersonville, Ind. The note in the March BULLETIN was not clear in connection with Lieutenant-Colonel Morris' responsibilities or his mailing address.

Catalogs and Literature Received

INTERNATIONAL ENGINEERING, INC., Dayton, Ohio. A 30-page booklet entitled "Mixing and Process Equipment" the purpose of which is to offer a sufficient background of general information to guide the user in selecting the best type of mixer for any specific mixing problems. Various types are described and illustrated, such as Propeller Mixers, Turbine Type, Slow Speed (paddle, anchor, gate, horseshoe, etc.). Other items covered include Unit Process Equipment, Complete Process Plants, Fans and Blowers, and Pebble and Ball Mills. Various engineering data and rules for selecting mixers are also given.

AMERICAN INSTRUMENT CO., 8010–8020 Georgia Ave., Silver Spring, Md. A four-page leaflet, Bulletin 2114, describing Electric Heaters and Controls for industrial and laboratory heating requirements. Illustrated.

CORNING GLASS WORKS, Corning, N. Y. An eleven-page booklet, Supplement No. 4 to Catalog LP21, October 30, 1943, entitled "New Items in Pyrex Laboratory Glassware Including Fritted Glassware." The following are illustrated and described: "Pyrex" Bottle and Bulb; Graduated Cylinders with Hexagonal Base; Funnels; "Pyrex" Brand Ball and Socket Joints; "Pyrex" Tubes; "Pyrex" Fritted Ware—Gas-Washing Bottles and Extraction Thimbles.

THE CHEMICAL RUBBER CO., 2310 Superior Ave., N.E., Cleveland, Ohio. A 120-page catalog, Supplement, "D2," entitled "Modern Laboratory Equipment." This Supplement should be filed with copies of Supplements "D" and "D1" for ready reference. New listings in this issue cover: Freas Ovens, Balances, "SeKo" Balances, Slomin Analyzers, Filter Candles and Crucibles, Scopes and Equipment, Safety Siphon, Tubing, Funnels, etc. Profusely illustrated.

LEEDS & NORTHRUP CO., 4943 Stenton Ave., Philadelphia, Pa. A 23-page catalog N-95-163 entitled "Micromax Condensate-Purity Instruments for the Steam Plant," revised edition. Describes how condensate is sampled continuously by means of a conductivity cell and its purity indicated and recorded automatically by means of a Micromax recording instrument. A simple controller which just signals and controls also is listed in this publication for the first time.

HARRY W. DIETERT CO., 9330 Roselawn Ave., Detroit 4, Mich. An eight-page leaflet describing the two-minute carbon determinator, three-minute sulfur determinator, Glotemp combustion furnace, and Varitemp combustion furnace.

GEORGE SCHERR CO., INC., 200 Lafayette St., New York 12, N. Y. Four-page illustrated folder describes Spencer binocular microscope for finish control; gives description of various models, features of construction, and related information.

TINIUS OLSEN TESTING MACHINE CO., 550 N. Twelfth St., Philadelphia 23, Pa. Bulletin 27. Equipment illustrated and described includes the motor-driven production machine in three types for testing on a 100 per cent inspection basis; accurate hand-operated machines for laboratory and limited production use; hydraulic elevating-type hardness testers; testers for rings, cylinders, tubing, etc., portable and semiportable machines adaptable to testing in any position or location desired; Baby Brinell testers for soft metals and thin sheet material and types for both hard and soft material, such as rubber; depth measuring instruments and proving rings for checking the accuracy of hardness testers.

Society Appointments

Announcement is made of the following Society appointments:

F. M. FARMER, Electrical Testing Laboratories, reappointed as A.S.T.M. representative on the ASA Standards Council for a term of three years.

SAM TOUR, Sam Tour and Co., Inc., representing Committee B-7 on the Advisory Committee of the Aluminum and Magnesium Division of the American Foundrymen's Association.

A Look Ahead

. . . . it seems inevitable that industry will be extended on world-wide lines, production will grow more scientific, research will expand, and engineers will multiply accordingly.

Engineers will find their way into every field where science needs to be practically applied, cost counted, returns predicted, and work organized systematically. They will be called upon to share the control of disease with physicians, the control of finance with bankers, the bearing of risks with underwriters, the organizing of distribution with merchants and purchasing agents, the supplying of food with packers and purveyors, the raising of food with farmers, and the operation of the home with housewives. In few of these new fields, if any, will engineers be self-sufficient; to be useful they must be teamworkers; and they must be prepared to deal with "men and their ways," no less than "things and their forces."

The engineering profession, it seems equally evident, will bear much heavier responsibilities in civic and economic affairs. It cannot afford to become either a narrow caste of highly skilled technicians or a free-for-all alumni association of engineering graduates. It will probably never be able to define its boundaries precisely, nor become exclusively a legal caste, nor fix a uniform code of educational qualifications. Its leaders will receive higher rewards and wider acclaim. The rank and file will probably multiply more rapidly than the elite, and rise in the economic scale to only a moderate degree.

The engineer's job will be so varied, and will change so fast, and his tools will so increase in variety and refinement with the advance of science, that no engineer can hope to get a once-and-for-all education in advance.

We should cease to think of education as a juvenile episode. We should expect to re-educate engineers either continuously or at intervals throughout their active careers. Once the needed means of after-college education are provided in ample degree the engineering colleges could broaden the scientific and humanistic bases of their curricula, cut down on early specialization, relieve overcrowded schedules, inspire independent work, and show the world the best balanced and best integrated of all modern disciplines.

Millions of individual, unrelated efforts will not add up to the future that invites our professions. This is no time for engineers to wrap themselves in the mantle of isolation; let us get together and be about our common business.

EDITOR'S NOTE.—This excerpt is from the very widely distributed address by President William E. Wickenden, Case School, entitled "The Second Mile, A Re-Survey." It has been revised and reprinted this year to present the engineering profession to the young engineer. The address is a thought-provoking, action-suggesting discussion which might well be read by every engineer. Copies of the complete address can be obtained from the Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N. Y., at 10 cents per copy; 5 cents in quantity; $3 per hundred.

Student Text on Testing of Engineering Materials

A NEW MATERIALS testing text for engineering students has been prepared by Professor Carl W. Muhlenbruch, Carnegie Institute of Technology, Pittsburgh, Pa., which makes use of references to A.S.T.M. standards. Professor Muhlenbruch, who is an A.S.T.M. member, has emphasized in his text the applications of experimental results, and except where of paramount importance, has minimized testing technique and detailed descriptions of procedures. He has included a short description of the Society and its standardization work. The large number of illustrations have been carefully selected; there are numerous charts. With each experiment is given a sample data sheet, and discussion questions which stress the more important parts of the experiment. The book covers a wide range of materials, but is so arranged that selections of tests can be made adaptable to various length materials testing laboratory courses. Copies of the 210-page book can be obtained from the publishers, D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, at $2.75.

Articles on Metallic Arc Welding Electrodes

AN INTERESTING series of articles on Arc Welding Electrodes has appeared in recent issues of *Steel* magazine providing pertinent information on applications and other problems in connection with arc welding. The author, Harold Lawrence, metallurgist and welding engineer, has used as a basis of his discussion specifications established in the joint A.S.T.M.-American Welding Society Specifications for Iron and Steel Arc-Welding Electrodes (A 233 – 43 T).

Reprints of these articles are being prepared and copies can be obtained from Readers' Service Department, *Steel*, Penton Publishing Co., 1213 West Third St., Cleveland 3, Ohio, at a nominal cost.

Index of Emergency Alternate Federal Specifications

MEMBERS AND others who are concerned with Emergency Alternate Federal Specifications can obtain from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents, a copy of the Quarterly Supplement to Section IV of the Federal Standard Stock Catalog which gives a list of the current Emergency Federal Specifications. The list is given alphabetically and also arranged according to the alphabetical-numeric list used in connection with Federal Specifications. The booklet dated March 1 also gives a complete list of the emergency alternate specifications which have been cancelled or superseded.

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